GUIDEBOOK

24TH. ANNUAL FIELD CONFERENCE OF PENNSYLVANIA GEOLOGISTS

MAY 15, 16, 17, 1959

Titusville, Pa.

Host

PENNSYLVANIA GEOLOGICAL SURVEY

Carlyle Gray, *State Geologist*

DEPARTMENT OF INTERNAL AFFAIRS

Genevieve Blatt, *Secretary*


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TWENTY-FOURTH ANNUAL FIELD CONFERENCE
OF
PENNSYLVANIA GEOLOGISTS

PROGRAM

Registration ---------- 10:00 A.M. to 12:30 P.M., Friday, May 15, 1959
and
7:00 P.M. to 8:00 P.M., Friday, May 15, 1959

Page

Trip A: Friday, May 15, 1959. The Glacial Geology of Crawford and Erie Counties, Pennsylvania -----Leave at 12:30 P.M. Friday by bus from Colonel Drake Hotel heading west on Route 27..... 1

Trip B: Saturday, May 16, 1959. Bedrock and Oil Geology of Northwestern Pennsylvania and the great Oildorado. Leave at 8:00 A.M. Saturday by bus from Colonel Drake Hotel heading north on North Franklin Street. Pick up box lunch in lobby at hotel before leaving..... 36

Smoker: Saturday, May 16, 1959, 8:00 P.M. Pithole Room Colonel Drake Hotel. Free beer and pretzels will be available courtesy of Quaker State Refinery Corporation, South Penn Oil Company, United Natural Gas Company, and Wolf's Head Oil Company.

Trip C: Sunday, May 17, 1959. Erosion Channel in Penn Dixie limestone mine. Leave at 8:00 A.M. Sunday by private cars from Colonel Drake Hotel at North Franklin Street entrance heading south. Pick up box lunch in lobby of hotel before leaving..... 59

INTRODUCTION
TO
THE GLACIAL GEOLOGY OF
CRAWFORD AND ERIE COUNTIES, PENNSYLVANIA

by

Vincent C. Shepps

The glacial geology of all of northwestern Pennsylvania has been studied in detail since 1952 by students of Dr. George W. White of the University of Illinois. These studies are at the time of this writing being prepared for publication by the Pennsylvania Geological Survey. In the area covered by this field trip report, studies were made by John B. Droste (eastern Crawford and Erie Counties) and by the writer (western Crawford and Erie Counties). The trip is designed to demonstrate the deposits and surface features formed by advances of ice into Erie and Crawford Counties during the Wisconsin Stage of the Pleistocene Epoch. The trip will pass through deposits of all of the Wisconsin advances and stops will be made to study at first hand the character of the material deposited by the various ice advances.

Northwestern Pennsylvania was glaciated on no less than seven occasions by continental ice of the Erie lobe which moved along the basin of Lake Erie from the northeast. Movement of ice into Pennsylvania occurred either as lateral spreading of the ice along the margin of the Erie lobe or as spreading of ice which moved into eastern Ohio as a tongue off of the Erie lobe called the Grand River sublobe. Advances of ice into Pennsylvania occurred twice during the Illinoian Stage and five times during the Cary substage. Distribution of these deposits is shown in Figure 1. Advances during the Cary substage have been given local names in Pennsylvania and Ohio which are shown in Figure 2. Figure 2 in addition shows all of the advances and the deposits laid down by the various advances.

The route of the field trip is shown on route map A and route map B.

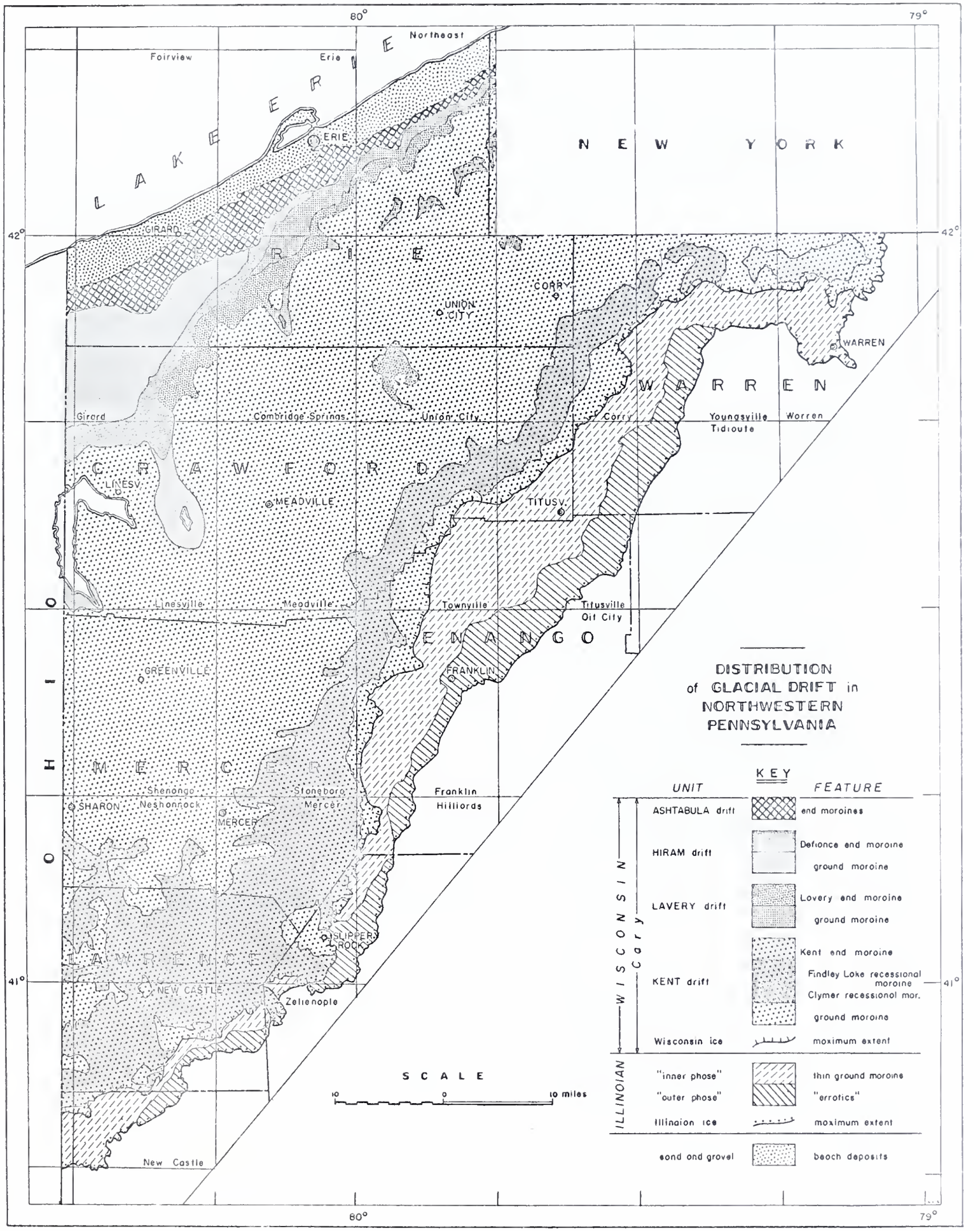

80°
79°
42°
41°
Northeast
Fairview
Erie
LAKE ERIE
ERIE
NEW YORK
GIRARD
CRAWFORD
WARREN
UNION CITY
CORRY
WARREN
Girard
Cambridge Springs
Union City
Corry
Youngsville
Tidioute
Warren
LINESV.
MEADVILLE
TITUSV.
Linesville
Meadville
Townville
Titusville
Oil City
VENANGO
GREENVILLE
FRANKLIN
MERCER
SHARON
Shenango
Neshannock
MERCER
Stoneboro
Mercer
Franklin
Hilliards
SLIPPERY ROCK
LAWRENCE
NEW CASTLE
Zelienople
New Castle
OHIO
SCALE
10 0 10 miles
DISTRIBUTION
of GLACIAL DRIFT in
NORTHWESTERN
PENNSYLVANIA
KEY
UNIT
FEATURE
WISCONSIN
Cary
ASHTABULA drift
end moroines
HIRAM drift
Defiance end moroine
ground moroine
LAVERY drift
Lovery end moroine
ground moroine
KENT drift
Kent end moroine
Findley Lake recessional moroine
Clymer recessionol mor.
ground moroine
Wisconsin ice
moximum extent
ILLINOIAN
"inner phase"
"outer phase"
thin ground moroine
"errotics"
Illinoian ice
moximum extent
sand and gravel
beach deposits

Figure 1

Figure 2

STRATIGRAPHIC SECTION

AGE	DEPOSITS	FEATURES
Pleistocene Epoch		
Wisconsin Stage		
Cary substage to Recent time	Sands and gravels, silts and clays	Beach deposits of Lake Erie
Cary substage		
Ashtabula time	Ashtabula Till Sand and gravel	Ashtabula Morainic System kames and outwash
Hiram time	Hiram Till Sand and gravel, silt and clay	Defiance Moraine ground moraine kames, outwash, and lake deposits
Lavery time	Lavery Till Sand and gravel, silt and clay	Lavery Moraine ground moraine kames, outwash, and lake deposits
Kent time	Kent Till Sand and gravel	Kent Moraine Clymer recessional moraine Findley Lake recessional moraine ground moraine kames and outwash
Tazewell substage	Tazewell till	ground moraine in subsurface
Illinoian Stage		
"Inner phase" time	Thin till Sand and gravel	ground moraine kames and outwash
"Outer phase" time	Erratics	ground moraine (?)

FIELD TRIP A
Friday, May 15

The Glacial Geology of Crawford and Erie Counties, Pennsylvania

Departure: 12:30 P. M. by bus from Colonel Drake Hotel

ITINERARY

Mileage

0.0 START Titusville at the Colonel Drake Hotel, drive west on Route 27.

0.4 Intersection of Routes 8 and 27, bear left on Route 27.

Titusville is built upon two different terrace levels. Going out of Titusville the road follows these terraces until it begins to climb onto the uplands approximately one-half mile out of Titusville.

After leaving Titusville the route on the upland surface is through the area of "inner phase" Illinoian ground moraine. In this area the topography does not appear to be glacial except for a possible "smooth" aspect. Soils, however, are developed upon thin, highly weathered till. Locally the tills, have been removed by erosion so that the till blanket is discontinuous. This till is thought to represent deposition by the second of two ice invasions during Illinoian time. Deposits of the first advance are found at the surface in the area mapped as outer phase Illinoian (Figure 1). In the outer phase Illinoian area the soils contain pebbles and erratics of foreign rock types. Seldom is a till as such preserved but a till thought to represent this advance has been found in a number of subsurface sections in areas south of here.

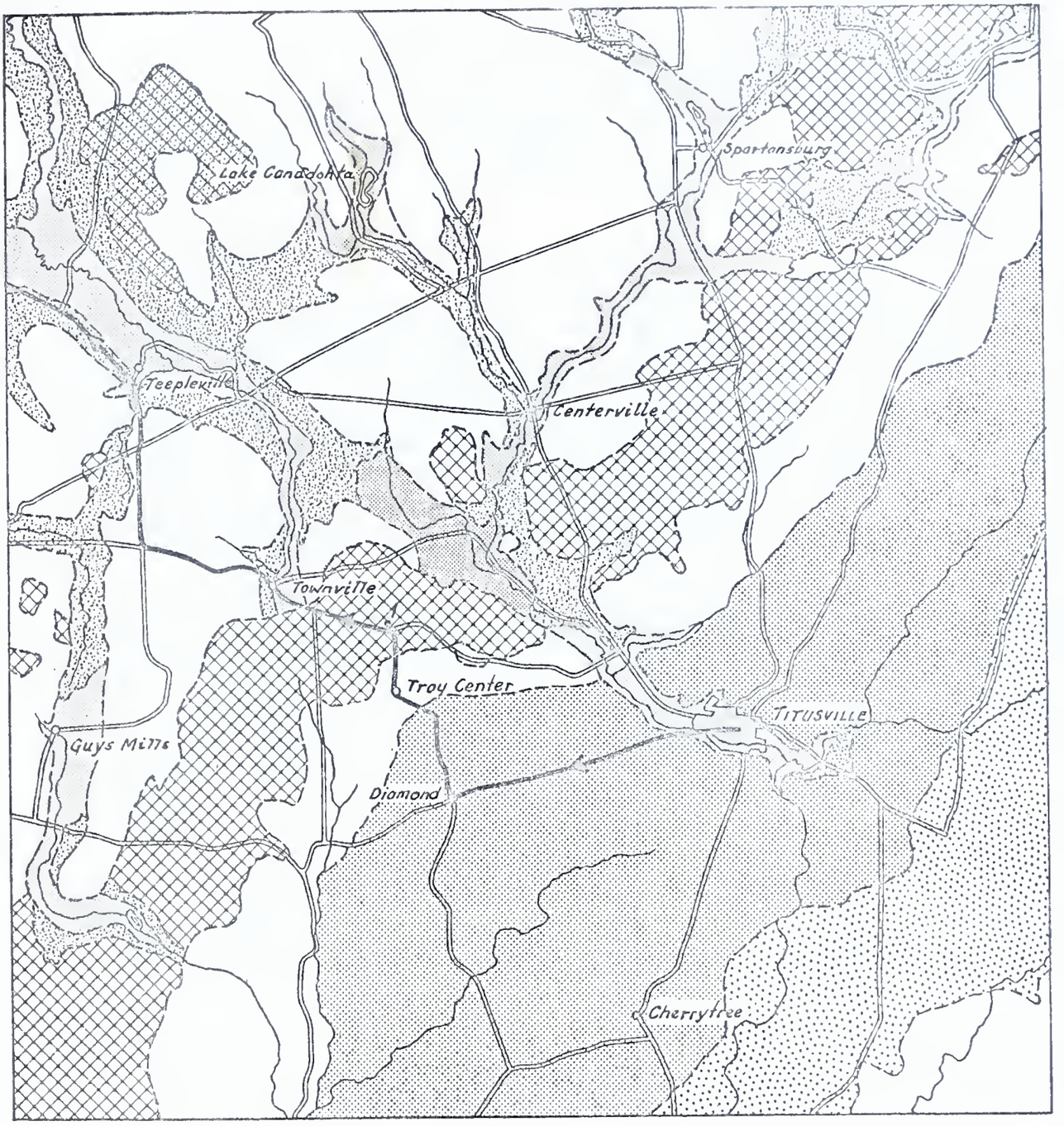
The "Kansan" of Leverett as shown on the Geologic Map of Pennsylvania (1931) and on the Glacial Map of North America (1945) cannot be substantiated and is considered to be incorrect. Most of the deposits thought by Leverett to be Kansan can be shown to be Illinoian. The area mapped here as outer phase Illinoian was also mapped as Illinoian by Leverett. No glacial deposits of any type have been found within the area mapped by Leverett as Kansan.

7.0 Intersection with Route 428, turn right onto Route 428.

Route follows inner phase ground moraine for 2.6 miles, then enters area of Kent ground moraine although the transition from one to the other is not apparent. The route is descending into a broad valley approaching Troy Center. The valley is filled with Kent valley train.

10.2 In Troy Center, turn right on Route 428.

Route is still in the Kent ground moraine. The ground moraine here is in front of the end moraine. This situation is normal in northwestern



ROUTE MAP "A"

WITH

Generalized Glacial Geology

SCALE

5 0 5 miles

LEGEND

- Kent ground moraine
- Clymer recessional m.
- Kent Moraine
- "Inner phase" Illinoian
- "Outer phase" Illinoian
- Kames & kame moraine
- Outwash

ECS.

Pennsylvania and nearly everywhere along the course of the Kent Moraine this ground moraine is present as a mile wide to three mile wide band. Only in southern areas is the band missing. The till in the ground moraine is the same as the till in the adjacent end moraine.

11.3 Entering Kent Moraine.

Hummocky topography of the Kent Moraine is noticable on all sides in contrast to the non-constructional topography of the Illinoian area. Undrained depressions are common in the Kent Moraine although open bodies of water are seldom seen. The Kent till of both the end and the ground moraine is a loam or a sandy loam till. In general the coarser tills are found in the end moraine. Studies of the texture of the Kent till show that the till becomes gradually coarser toward the southeast. In the extreme southeast the till is sometimes a sandy till.

The Tazewell till in northwestern Pennsylvania does not appear at the surface. Its advance appears to have stopped at some distance behind the Kent Moraine, for no Tazewell till is found anywhere in the area of the Kent Moraine, or for a number of miles behind the Kent Moraine. Tazewell till is found most commonly in subsurface in western Mercer County and southwestern Crawford County.

11.6 Intersection with Route 408. Route 428 ends, turn left onto Route 408.

STOP 1 KENT TILL This is intended to be a brief stop to examine the Kent till which is exposed in the road cuts. The cuts are not high enough to allow calcareous till to be seen, but till at the base of the cuts is sufficiently fresh to show the normal character of the Kent till.

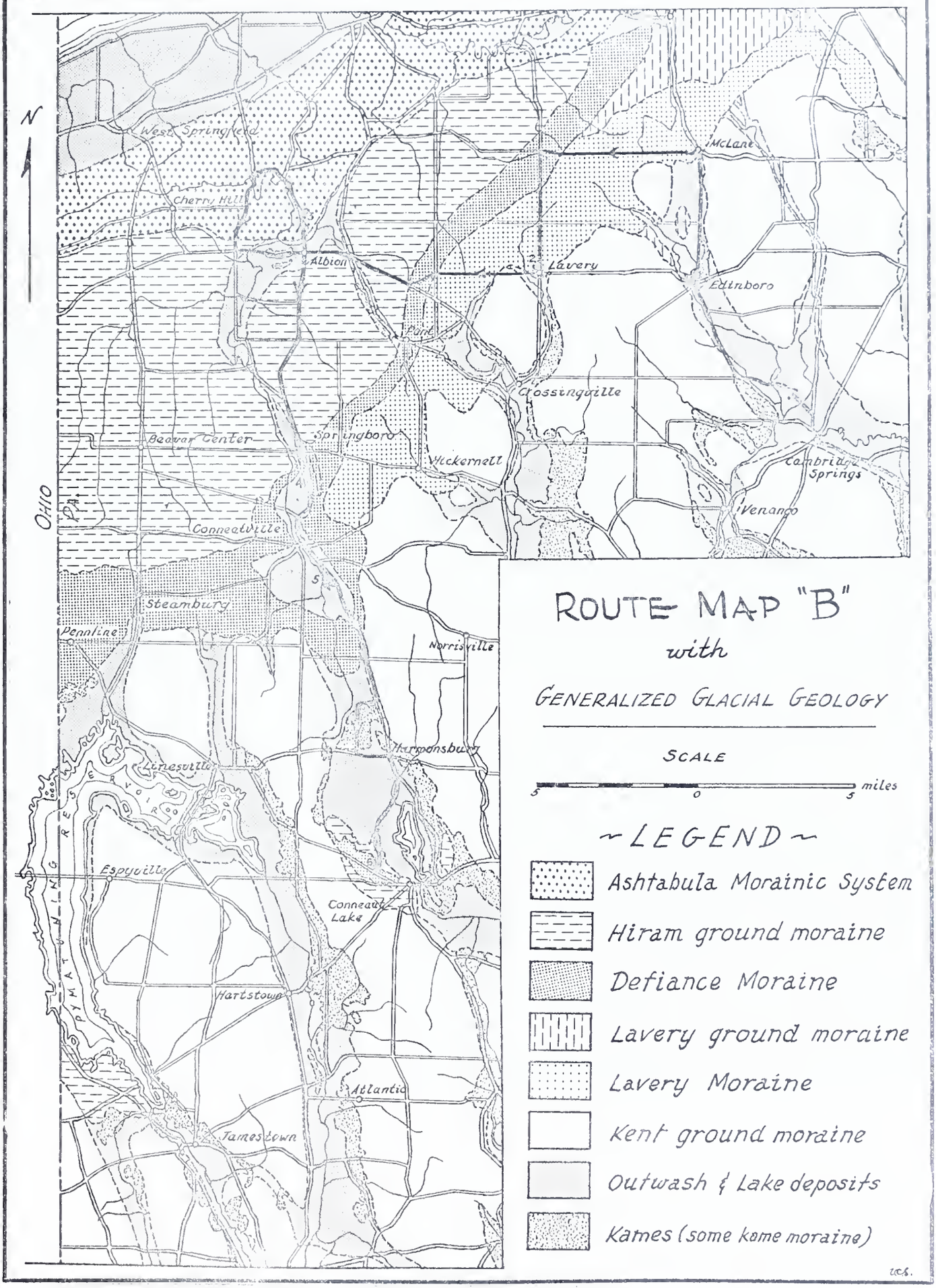
After the stop the route is through the Kent Moraine for approximately 6 miles. Hummocky topography persists along the route and the till remains the same as that seen at Stop 1.

17.1 Leaving the Kent Moraine, entering the area of Kent ground moraine.

The route for the next fourteen miles is through the Kent ground marine. The topography on the upland surfaces and the broad valley slopes is essentially smooth and non-constructional. Constructional topography when seen in the ground moraine area is invariably upon kames or kame terraces, features which abound in the Kent ground moraine area. Till in the ground moraine is generally thin on the uplands and the valley slopes and thickest in the valley bottoms. In the areas where the Tazewell is present beneath the Kent ground moraine the total till over bedrock is somewhat thicker.

Continue straight ahead through Townville.

21.0 Junction with Route 78, turn right on Route 408.


N
OHIO
PA.
West Springfield
Cherry Hill
Albion
McLane
Lavery
Edinboro
Girard
Crossingville
Springboro
Beaver Center
Hickernell
Cambridge Springs
Venango
Conneautville
Steamburg
Pennline
Norrisville
Harmonsburg
Linesville
Espyville
Conneaut Lake
Hartstown
Atlantic
Jamestown
SHENANGO RESERVOIR
ROUTE MAP "B"
with
GENERALIZED GLACIAL GEOLOGY
SCALE
5 0 5 miles
~LEGEND~
Ashtabula Morainic System
Hiram ground moraine
Defiance Moraine
Lavery ground moraine
Lavery Moraine
Kent ground moraine
Outwash & Lake deposits
Kames (some kame moraine)
W.S.

Mileage

23.4 Intersection with Route 77, turn right on Route 408.

23.6 Turn right on Route 408.

25.0 Descend into valley near Miles Corners.

Low knobby topography on kames is present on both sides of the road. From here to Cambridge Springs the route is along the south side of the valley of Muddy Creek and then French Creek after it is joined by Muddy Creek. The road after Miles Corners is following a low kame terrace (or high river terrace).

29.0 State Game Farm

The road here leaves the high terrace and drops down onto a lower terrace. The wide flat valley bottom to the right (northeast) continues to become wider as Cambridge Springs is approached. The valley bottom just beyond Cambridge Springs reaches a maximum width of nearly 2.5 miles across and has less than 30 feet of relief. This extensive valley filling consists of Lavery outwash (valley train) which was probably ponded in the vicinity of Cambridge Springs and eastward. The valley at depth is probably filled with Kent and earlier drift, and represents a pre-glacial valley. Leverett felt that it may have been one of the major north-flowing valleys in pre-glacial times. Depth to bedrock is known to exceed 200 feet in a well just southeast of Edinboro and a number of other measurements encounter fill greater than 100 feet. The outlines of the buried valley are not known, but no deep buried valley has been found north of Edinboro and especially across the lake plain to suggest that this valley becomes larger or deeper northward. It seems likely under these conditions that the valley was not used by a major north-flowing stream, but by a major tributary flowing southward into the old Middle Allegheny System of Chamberlain and Leverett (1894) via a channel in the position of Muddy Creek and parts of upper Oil Creek. This channel was choked by the Kent Moraine and by Kent kames, and with the retreat of the Kent ice the ponding of French Creek valley may have begun. Ponding would have filled the valley to the level of a low col between Cambridge Springs and Meadville. Subsequent erosion of the col lowered the level of the lake gradually and at the same time created a new channel for French Creek. Ponding as described above may account for some of the terraces above the main valley bottom deposits, but detailed work has not been done on the terraces to demonstrate this relationship.

32.4 Enter Cambridge Springs.

33.0 Turn right on Route 19.

33.1 Turn left on Routes 86 and 99 after crossing bridge.

33.3 Turn right on Route 99 and follow it to Edinboro.

Mileage

The road from Cambridge Springs to Edinboro follows the surface of the Lavery outwash filling the valley bottom. Note the width of this fill. As Edinboro is approached the gradient of the valley train surface increases faster than the gradient of the present stream so that the stream becomes increasingly "entrenched" into the valley train surface. This entrenching is especially noteable just before entering Edinboro where the stream is flowing parallel to the road.

35.0 Intersection with Route 6N at stoplight in Edinboro. Continue straight ahead on Route 99. North out of Edinboro the road passes to the right of Edinboro Lake and travels along somewhat dissected Lavery outwash and Lavery kames. The valley well on the right (east) is covered in part by Kent ground moraine and in part by Lavery kames.

In this area north of Edinboro the Lavery valley train continues to fill the valley bottom but with a steeper gradient than on the valley train south of Edinboro. Edinboro Lake is situated in the center of the valley train. The main Lavery end moraine is situated approximately three miles north and northwest of Edinboro. However, the town of Edinboro is sitting on a kame moraine- outwash complex also of Lavery age. This seeming contradiction is one which is repeated in a number of places across northwestern Pennsylvania. With the first advance of the ice the leading edge of the ice mass was sufficiently plastic to allow tongues of ice to move into valleys in advance of the main ice mass. At Edinboro two tongues moved ahead of the main ice mass, joined just north of the town and advanced to the approximate site of the town. At this position the combined tongues deposited a moraine composed not of till, but of sand and gravel (kame moraine). Materials were carried away from the ice front and were deposited as outwash in the valley to the south.

Because of their overextension these tongues stagnated while the main ice mass to the north continued to advance and build up a major end moraine. Meltwaters flowed from the front of the main moraine and filled the valley abandoned by the melting ice tongues with outwash. At the position of Edinboro Lake a mass of ice from one of the tongues remained unmelted until after meltwaters from the north ceased to flow. Later melting of this ice mass left a water filled depression now called Edinboro Lake. Edinboro Lake is consequently an ice block depression.

38.9 Approaching McLane, take road to the left.

Knobby topography on the right after the turn is on kame moraine of the main Lavery Moraine. Road is in the kame moraine for approximately .8 mile after the turn and then passes through the Lavery Moraine (till) for 3.6 miles. The till moraine is rather subdued with only an occasional tract of hummocky topography. Throughout much of its extent it is gently rolling with rare poorly drained areas. The till of the Lavery advance is a silt till noticeably finer grained than the Kent till.

Mileage

Shortly after the route passes the crossroads called Mishlin Corners, the till at the surface becomes more clayey and the road is now in the Defiance Moraine of Hiram age. (This moraine is not called the Hiram Moraine following the previous pattern since it was earlier named the Defiance Moraine in Ohio.) The Hiram till is a clay or silty clay till. The Defiance Moraine is compounded with the Lavery Moraine in this area and it is not possible to delineate accurately either the inner or outer margins of the Defiance Moraine except by studying the till at the surface. The Defiance Moraine is very subdued in this area but becomes stronger going westward. Much of the tracing of the Defiance and the Lavery Moraines has been done with the aid of aerial photographs.

44.0 At intersection called Franklin Corners, turn left onto Route 98.

Route is still in the Defiance Moraine at Franklin Corners.

45.3 Approximate outer margin of the Defiance Moraine (Hiram till).

47.8 STOP 2 LAVERY CROSSROADS

Crossroads, intersection with route 6N. This is the type area for the Lavery Moraine and the Lavery till. The morainic expression along the road north of here is considered to be typical of the Lavery Moraine and till in the road banks is typical Lavery silt till. Walk north from the intersection to see Lavery till in the road banks. Again the banks are not high enough to show calcareous till, but the till is fresh enough to show its normal character.

After stop turn right (west) onto Route 6N toward Albion.

48.1 Crossing marginal channel along the front of the Lavery Moraine, entering Kent ground moraine.

49.2 Crossing marginal channel and going back into the Lavery Moraine. This channel shows exceptionally well on aerial photographs.

The route for the next 3.3 miles is through the Lavery Moraine and then into the Defiance Moraine. The change from one to the other is not obvious. After 3.3 miles the route leaves the Defiance Moraine and enters the area of Hiram ground moraine. The surface in the ground moraine area is devoid of constructional topography and undrained depressions are extremely rare.

54.0 Lundys Lane, continue straight ahead on Route 6N crossing valley in which bedrock is exposed. The route has been coming down a gradual north-dipping slope after leaving the Defiance Moraine. This slope eastward becomes progressively steeper until it is a distinct escarpment. Till along this slope and along the escarpment is very thin. The escarpment controlled the advance of the Hiram as well as the later Ashtabula ice.

Mileage

54.9 Enter Albion.

Just as the route crosses the railroad tracks in Albion the materials at the surface change from Hiram till to sand and gravel representing outwash from the next advance after the Hiram, the Ashtabula advance.

55.5 Turn right at North Main Street traffic light.

55.7 Good Ashtabula outwash terraces to the right and directly ahead as the route approaches and crosses the creek.

56.9 STOP 3 ASHTABULA TILL

Cut in Ashtabula till revealing a complete section from the surface down to unleached, unoxidized till. Note the shallow depth of leaching and oxidation and the texture of the till. It is a silt till which is almost identical to the Lavery till.

The route since Albion has been through the southernmost of two moraines belonging to the Ashtabula Morainic System (Leverett's Lake Escarpment Morainic System). The southernmost moraine was named the Ashtabula Moraine by Leverett (1902). From this top the route continues north across low terraces and recent alluvium and then rises onto the northern of the two moraines, the Painesville Moraine (Leverett, 1902). The topography on all of the Ashtabula moraines is boldly constructional, knob and kettle topography. The route through the northern moraine does not show the topography well because it passes through an area of moraine-outwash transition and not through the true moraine.

59.5 Intersection with north-south road, turn left (south).

Road descends into valley which divides the northern moraine from the southern moraine and marks the position of the marginal channel in front of the northern moraine. Drainage from the Ashtabula moraines was blocked from flowing southward by the north-dipping slopes and the escarpment and was forced to flow westward. After rising out of the valley the road crosses the Painesville Moraine.

The Ashtabula moraines were deposited en-echelon along the southern shore of Lake Erie as far west as Cleveland. Because of this en-echelon arrangement there are always at least two moraines and commonly three moraines running parallel to each other. The tills become gradually coarser westward.

62.0 Cross weak marginal channel and enter Hiram ground moraine. The till in the Hiram ground moraine is nearly the same as the till in the end moraine but is slightly coarser grained being commonly a silty clay till. Depth of leaching is usually between 3 and 4 feet. At many places in the ground moraine area, the Hiram till appears to be so thin that it makes up only the upper foot or two of the soil profile.

Mileage

62.4 Intersection with 6N, turn left (east) toward Albion.

Route is across Hiram ground moraine and Ashtabula outwash.

64.6 Intersection with route 18 at traffic light in Albion, turn right (south) onto Route 18.

Driving across upland through Hiram ground moraine.

69.8 Entering Defiance Moraine

Moraine is weakly developed but becomes gradually stronger going south.

71.1 Enter Springboro, continue on Route 18.

72.4 Gravel pit in Hiram Kame on the left.

73.2 STOP 4 HIRAM TILL

Road cuts along the road in front of the Conneaut Valley High School and south from there show Hiram clay till. (This is a main route, watch for automobiles!!!)

After stop continue on Route 18 through Conneautville. Note various terrace levels to the right (west) of the road before entering Conneautville, and to the left (east) after entering Conneautville. The route is still within the Defiance Moraine but is following lake and river deposits in Conneaut Valley. The lake deposits are Hiram in age and have a rather complex distribution here and to the south.

Lake deposits in this area are found at a number of levels with the highest being just below 1060 feet elevation. Going south out of Conneautville the topography along the route becomes strongly hummocky, kame and kettle topography which contains numerous small ponds. None of the ponds however, are visible from the road.

76.4 Turn right onto gravel road.

76.7 Intersection, turn right.

76.9 STOP 5 LAKE DEPOSITS

Cuts on the right of the road contain bedded (varved) silts and fine sands (Figure 3). These are very similar to materials found throughout this part of Conneaut Creek valley and are considered to be lake sediments. The kame and kettle topography is developed upon these sediments. This can be explained most satisfactorily if it is considered that the sediments were deposited in a lake which existed in the presence of a stagnant,

Figure 3 Varved yellow-brown silts and fine sand deposited in a pre-Hiram lake. Deposition is thought to have occurred in water ponded in the presence of a decaying ice mass in Conneaut Creek valley. Distortion of bedding is attributed to slumping which attended melting of the ice mass after deposition of the sediments. Topography on the surface of these sediments is strongly hummocky, kame and kettle topography.

Mileage

decaying ice mass. Distortion of the varves can be attributed to slumping after disappearance of the ice.

After stop continue straight ahead, take first right and return to Route 18.

77.4 At intersection with Route 18, turn right.

Once again route is through the kame and kettle topography developed upon lake sediments. These deposits continue for several miles. Note silts in the road cuts as evidenced by wet streaks, slumping, and the lack of pebbles.

78.4 Gravel pit and knobby topography on the left. Road is running parallel to a Defiance kame moraine which to the south forms a loop across the valley. Going south the road will pass through the loop, but it is still in the lake deposits and will continue in them for another 1.5 miles. This kame morain is part of the main Defiance Moraine.

78.8 Gravel pit on the left.

This is the end of an esker which trends NW-SE. High hills beyond the esker are still composed of lake silts. Coming down off of the highest hill the road enters the Defiance kame moraine after crossing several small streams.

79.9 Gravel pit in the kame moraine.

Leaching in the Defiance gravels averages approximately 6 feet. From here the road rises onto the upland in the kame moraine.

80.7 On the upland in the Kent ground moraine.

Bedrock is near the surface all along the road until the next turn and is exposed in some of the cuts along the left side of the road. The route is now south of the Defiance Moraine and Conneaut Creek Valley on the left is no longer choked with kame and kettle topography. Note the open appearance of the valley. The valley bottom here contains terraces composed of yellow silts and sands much like those seen at Stop 5. These are still lake deposits indicating that an open body of water filled this part of the valley. The terraces in the bottom of the valley range from 20 to 60 feet above present stream level and in general slope toward the center of the valley. This suggests that the lake was never completely filled and in fact may have been gradually dropping during deposition.

82.6 Turn right onto gravel road leading down into the valley bottom.

83.4 Turn left at intersection.

Mileage

Note yellow silts in the road banks at this intersection. After turn, the hills ahead contain sand and gravel and represent part of a kame moraine which is a recessional moraine of Hiram age. Once again as at Edinboro a tongue of ice moved ahead of the main ice mass and formed a moraine in front of the main moraine. Unlike Edinboro, it is not the outermost moraine formed by the tongue.

84.6 Coming over the crest of the highest hill.

Straight ahead is a wide, flat, outwash plain. On both sides of the road strongly rolling topography with undrained depressions can be seen.

Though not apparent from the road, the rolling topography is in the form of long linear ridges deposited parallel to an ice front. These linear ridges are striking features on aerial photographs, and can be seen better after the next turn. It is this kame moraine which blocked the south-flowing drainage and ponded the waters to the north.

85.0 Intersection with paved road, turn left.

Route to Harmonsburg follows the north edge of the outwash plain. Note linear ridges to the north just after turn and outwash to the south. Gravel pits on the left and on the right show that the gravels of the outwash plain are leached approximately 6 feet. On the left after the gravel pits is a lake formed where peat was removed from a large bog.

86.0 In Harmonsburg, intersection with Route 18, turn right onto Route 18.

86.5 Gravel pit on the left and Conneaut Lake ahead. Note flatness of the plain ahead.

86.9 Turn right onto Route 618.

The route leads south across the surface of the outwash. Ponding may have occurred to explain the flatness of the surface in some places. Along the valley slopes to the left (east) is a well developed kame terrace of Hiram age. This was formed along the edge of the ice tongue by meltwaters flowing to the south. The route leads around the west side of Conneaut Lake where the depth to bedrock is known to exceed 300 feet. After passing Conneaut Lake Park, the road rises slightly and the topography becomes knobby. This is interpreted as kame moraine deposited by the Hiram tongue.

This valley is considered by most glacial geologists to have been the principle outlet to the north for the waters of the pre-glacial Allegheny River System.

90.0 Material at the surface changes from sand and gravel of the kame moraine to

Mileage

clay till. Topography along the road is constructional but subdued. Elsewhere it is rolling to knobby. This is interpreted as end moraine of the Hiram tongue.

90.2 STOP 6 HIRAM TILL of the end moraine.

Hiram clay till is exposed in the road banks. Note the shallow depth of leaching and the texture.

In the excavation for the schoolhouse just ahead at the intersection an excellent section was exposed which showed: 4 feet of clay till leached 3 feet 10 inches, over 12 feet 2 inches of leached sand and gravelly sand, over 4 feet plus of sandy loam till leached 2 inches and oxidized 3 feet 4 inches. This section is interpreted as showing Hiram till over Kent glaciofluvial deposits over Tazewell till.

END OF THE TRIP

INTRODUCTION
TO
BEDROCK AND OIL GEOLOGY OF NORTHWESTERN PENNSYLVANIA AND THE GREAT OILDORADO

by

William S. Lytle

THE STORY OF THE DRAKE WELL

Petroleum Beginnings

For over two centuries before Colonel Edwin L. Drake drilled his famous well, petroleum was known to exist in the United States. In the 17th century Franciscan and Jesuit missionaries are said to have alluded to oil in western New York, one describing a spring near present-day Cuba, New York, as containing a "thick and heavy water, which ignites like brandy and boils in bubbles of flame when fire is applied to it." In the 18th century there are reports of trade in oil brought to Niagara by the Seneca Indians; this probably gave rise to the early name for petroleum, "Seneca Oil." Lewis Evans' "Map of the Middle British Colonies in America," published in 1755, is the earliest known document to indicate the existence of petroleum in Pennsylvania.

Prior to 1845, the greatest source of petroleum in Pennsylvania, as well as in the United States was along Oil Creek. As white settlers moved into this region and settled along this creek, they began to skim petroleum from little springs either in the bank or in the actual bed of the stream. Sometimes, this was done by floating a woolen or flannel cloth or a blanket on the water, wringing the cloth out when it was saturated with petroleum. They valued and used the oil exclusively as medicine.

According to one story the old pits which once dotted the land above and below the junction of Oil Creek and Pine Creek, a short distance south of Titusville, represent a very early - possibly a prehistoric - phase of this process for obtaining oil.

The First Petroleum Companies

In 1851 Dr. Francis Beattie Brewer, a graduate of Dartmouth College and a practicing physician moved from Massachusetts to Titusville to join his father's lumber firm, Brewer, Watson and Company. Immediately he became interested in an old oil spring located near Upper Mill on the Hibbard farm, the company's property, about two miles below Titusville and within a few rods of Oil Creek. In the fall of 1853,

he carried a small bottle of petroleum on a trip to Hanover, New Hampshire, to visit friends and relatives. While he was there, both Dr. Dixi Crosby, of the Dartmouth Medical School, and Professor O. P. Hubbard, of the Chemistry Department of Dartmouth College, examined the sample and pronounced it very valuable. A few weeks later George H. Bissell, Esq., another graduate of Dartmouth and a young lawyer in New York City, returned to his home in Hanover, saw the bottle of petroleum in Crosby's office, and wondered if petroleum could not be used as an illuminant. Aroused by the prospect, Bissell and his business partner, Jonathan G. Eveleth, decided, provided that a sufficient supply of petroleum could be found, to organize a company, buy the land, develop the oil spring, and market petroleum. After much negotiation and several trips to Titusville, Bissell and Eveleth purchased the Hibbard farm on November 10, 1854, for $5,000. Furthermore, on December 30, 1854, they organized the Pennsylvania Rock Oil Company of New York, the first petroleum company in the world.

Hard times, the dubious character of the venture, the ignorance of the value of petroleum, the lack of confidence in the promoters, and the fact that in the State of New York stockholders of joint stock companies were liable for all debts of the company, made it exceedingly difficult to sell stock. In April, 1855, Professor Benjamin Silliman, Jr., of Yale College, whom the promoters had employed to analyze the oil, made his report and pointed out its economic value. This proved to be a turning point in the establishment of the petroleum industry. A number of New Haven capitalists, headed by James M. Townsend, impressed by Silliman's report, agreed to buy stock, provided the company was reorganized under the liberal corporation laws of Connecticut. Under these circumstances, Eveleth and Bissell abandoned the original company, formed the Pennsylvania Rock Oil Company of Connecticut on September 18, 1855, with a capital stock of $300,000.

Owing to the lack of harmony which unexpectedly developed between the New Haven and New York stockholders, little progress was made. Consequently, Townsend and the other New Haven men decided to organize another company, lease the land, drill for oil, and monopolize the oil business. Thereupon, they organized the Seneca Oil Company on March 23, 1858, leased the Titusville property from the Pennsylvania Rock Oil Company of Connecticut, elected Edwin L. Drake as General Agent at an annual salary of $1,000, and sent him to Titusville in the spring of 1858 to drill for oil.

Edwin L. Drake

Drake had spent the first years of his life on farms in New York and Vermont. With a common school education, he left home at the age of nineteen for the West. At Buffalo he secured a job as a night clerk on a ship playing between that city and Detroit. During the next few years he was successively a hotel clerk in Michigan, a clerk in a dry goods store in New Haven and in New York City, and an express agent on the Boston and Albany Railroad. In 1849 he became a conductor on the New York and New Haven Railroad and moved to New Haven. During the summer of 1857 Drake fell ill and, although not prostrated, was compelled to relinquish his position with the railroad. While living at the Tontine Hotel in New Haven, he became acquainted with Townsend, talked with him about petroleum, and finally purchased $200 worth of stock in the Seneca Oil Company.

Without boasting about what he expected to do, Drake went quietly about his work in Titusville to dig a well at the site of the principal spring on the Hibbard farm. After several weeks of excavating, the workmen struck a vein of water that drove them out of the well; Drake abandoned the works and decided that it would be cheaper to drill. Without any previous experience in drilling, Drake went to Tarentum, Pennsylvania to observe the manner of drilling salt wells, to consult with salt-well owners, and to engage a driller. Upon his return home, he ordered a six-horse power steam engine and a "Long John" stationary, tubular boiler, to furnish power for drilling. He designed and built an enginehouse and a derrick, in which to swing the drilling tools. By August everything was in readiness for the driller but he failed to appear. Since Drake could not find another and the season was late, he installed his engine and boiler, then suspended operations for the winter.

In the spring of 1859 Drake secured the services of William A. Smith of Salina, who had worked on the salt wells at Tarentum. He agreed to do the drilling for $2.50 a day and "throw in" the services of his fifteen-year-old boy. Smith made the drilling tools - the kind that were commonly used in drilling a salt well - for Drake at Tarentum. They cost $76.50 and weighed between one and two hundred pounds. From Erie, Drake secured some cast-iron pipe in sections ten feet long. With a white oak battering ram, lifted by an old fashioned windlass, they drove the pipe thirty-two feet to bedrock and, about the middle of August, began to drill with steam power, averaging about three feet a day.

Striking Oil

On Saturday afternoon, August 27, as Smith and his sons were about to quit work, the drill dropped into a crevice at a depth of sixty-nine feet from the surface and slipped downward six inches. The men pulled out their tools and went home without any thought of having struck oil. Late Sunday afternoon "Uncle Billy," as Smith was known, visited the well, peered into the pipe, and saw a dark fluid floating on top of the water within a few feet of the derrick floor. Excited and overwhelmed, "Uncle Billy" sent his boy running to Upper Mill crying, "They've struck oil!" Quickly the news spread and the dwellers along the creek rushed into Titusville yelling to everyone as they met, "The Yankee has struck oil!" In the excitement no one thought of gauging the well but the best evidence indicates that it produced petroleum at the rate of about eight to ten barrels a day.

Drake seemed pleased to have successfully completed his well, but did not appear greatly excited or wildly enthusiastic. It is dubious whether he or others realized the significance of his achievement. In time the meaning of what he had done became clearer. Drake had demonstrated in a practical way how petroleum could be secured in greater abundance, and his well served as a textbook for future drillers; he had tapped the vast subterranean deposits of petroleum in the great basin of Oil Creek; and he had ushered in a new industry which provided the world with a cheap, safe, and efficient illuminant. Not only that, but on the eve of a mighty industrial expansion, Drake had opened up a source of unexcelled lubricating oil, an item of utmost importance to the Machine Age.

Upon the completion of his well, Drake ceased to a factor in the development of the petroleum industry and others came in to take advantage of his achievement.

After serving as a Justice of the Peace and buying oil for New York merchants, he left Titusville in 1863, soon lost everything he had saved by speculating in oil stocks, became the victim of a neuralgic affliction, and spent the rest of his life in an invalid chair. In 1873 the State Legislature of Pennsylvania provided him with an annual income of $1,500 until his death in 1880; the pension then went to his widow for her lifetime.

Memorials to Drake and his Well

The first movement to honor Drake and memorialize his famous well realized its goal on October 4, 1901, when a magnificent monument to the memory of Colonel Drake, the generous gift of Mr. Henry H. Rogers, was unveiled and dedicated in Woodlawn Cemetery,Titusville. Within a short time the body of Colonel Drake was exhumed at Bethlehem, Pennsylvania, and removed to Woodlawn Cemetery. The second movement, one for preserving and marking the site of the Drake Well, was inaugurated by the Canadohta Chapter, Daughters of the American Revolution, Titusville. About 1908 Mrs. David Emery donated to the Canadohta Chapter one acre of land upon which the Drake Well had been drilled. Upon this spot the women of this organization placed a native boulder, weighing about thirty tons, and on August 27, 1914, they placed on the stone a large bronze tablet with a replica in bas-relief of the Drake Well and an inscription dedicating the boulder.

Drake Well Memorial Park

Through the efforts of a group of public-spirited and historically-minded citizens - John H. Scheide and James H. Caldwell of Titusville, S. Y. Ramage of Oil City, and A. R. Wheeler of Endeavor, and many others - the third movement was initiated to memorialize the birthplace of the petroleum industry by something more than an inanimate marker.

As a result of this movement the Board of Directors of the American Petroleum Institute voted in January, 1931, to raise $60,000 to construct a dike to keep the site of the Drake Well from being flooded, clear the ground, excavate and drain the area, construct and furnish a caretaker's house, and establish a museum and library, provided the Commonwealth would accept the property as an historical park and appropriate an annual sum for its proper maintenance and development. When all the improvements had been completed in the spring of 1934, the Commonwealth formally accepted the property on August 27, 1934, at the Diamond Jubilee celebration of the drilling of the Drake Well. At that time, the park included about twenty-four acres; since 1934 additional land has been donated until there are now about two hundred and twenty-nine acres.

In 1945 the D.A.R. monument was moved to the west side of the center oval and a replica of Drake's enginehouse and derrick was erected on the original site of the well. An old engine and steam boiler and other machinery typical of the early days was installed so that the well might be pumped in a simulated manner. As a part of a master plan to improve and enlarge the present park facilities, a new room was added to the west of the museum building in 1949. When the entire structure is completed, all of the exterior will be of Pennsylvania sandstone.

THE DRAKE WELL and COLONEL DRAKE
1861

The Drake Museum

The Drake Museum is a treasure-house full of all sorts of historical materials and relics pertaining to the early history of the petroleum industry. Each year since 1934 the collection has been enlarged and enriched through the generosity of friends who have donated materials of all kinds. Today the Drake Museum is the largest single depository in the country for historical records and relics on the early history of the petroleum industry. Anyone who desires to donate historical materials or who knows of persons who might have such records and relics is requested to write to the Curator, Drake Well Memorial Park, Titusville, Pennsylvania.

The Drake Well Memorial Park is administered by the Pennsylvania Historical and Museum Commission. An Advisory Board of seven members, appointed by the American Petroleum Institute, makes recommendations to the Commission for the maintenance, improvement, and development of the institution. A Curator is in direct charge of the property.

PITHOLE

Vanished City of Oil
Where The Pipe Line was Born
in 1865

The borough of Pithole City got its name from Pithole Creek, along whose banks the first wells in the soon-to boom region were drilled. Pithole Creek earlier had been named for deep fissures or "pits" in the rocks high on a hill on the west side of the creek near the point where it empties into the Allegheny River.

Pithole City was located in Cornplanter Township, Venango County, about five miles up the creek from the Allegheny.

In 1864 the region was a wilderness. There were two small farms carved out of the forest by two brothers, Thomas Holmden and Walter Holmden, whose father had been an early missionary in the region. It was on the Thomas Holmden land that the city was built and many of the wells drilled, especially the most productive wells. Log cabins for the two families were the only structures there before the discovery of oil. The Holmdens and their neighbors of some distance away, the Copelands and the Rookers, spent their time raising buckwheat and hunting deer.

Gamble on Finding Oil

At Plumer, four miles in the direction of Oil City, was situated the Humboldt refinery, one of the most famous in the oil region at that time for its advanced methods. Two employes of that refinery, I. N. Frazier and James Faulkner, leased 65 acres in the spring of 1864 on the part of the Thomas Holmden farm that lay on the flat land along the creek, proposing to drill for oil. This was truly a wildcat venture because at that time virtually all the petroleum - oil, that is - produced in the world came from wells along Oil Creek and the Allegheny River. Many persons thought it extremely un-

likely that oil would be found in the wild and inaccessible hills 5 1/2 miles from Oil Creek. However, Frazier and Faulkner made a lease with Holmden giving him one-fourth of the oil. They formed the United States Petroleum Company and selected a spot to drill by the means of a witch hazel twig. Soon they began a well that later became known as the Frazier well. Before the well was finished Thomas G. Duncan and George C. Prather bought the Holmden farm, subject to the lease, for $25,000. On January 7, 1865, the Frazier Well began to flow oil at 250 barrels a day. A barrel is approximately 42 gallons. The stock of the U. S. Petroleum Company jumped from $6.25 to $40 a share. Duncan and Prather realizing they had a good thing on their hands- and possibly prodded by their consciences - re-negotiated their deal with Holmden and agreed to pay him $100,000 instead of $25,000, and also gave him the royalty of the well.

Excitement in the Oil Region was intense and drilling for another well was begun. In April, the historic month that saw the end of the Civil War, a Boston company completed a well known as the Homestead Well just 100 feet outside the boundary of the Thomas Holmden farm. It also flowed 250 barrels. John Wilkes Booth once paid $13,000 for one-thirteenth interest in this well but sold out before its completion.

Throngs Move on Pithole

Because of the discovery of oil on a location hitherto regarded as unpromising and at a considerably higher altitude than Oil Creek, the Frazier and Homestead Wells created a tremendous demand for land in that vicinity. The stampede to Pithole Creek was on and it soon surpassed anything the oil region had seen. Hundreds thronged the roads leading to Pithole, on foot, on horseback, in stages and in wagons.

Other factors contributed to the boom. The end of the Civil War found the country flooded with paper currency whose holders were anxious to invest it and make more money. Thousands of soldiers had been discharged from the army. Some were eager to get jobs of any kind and others were anxious to make a fortune quickly after having lived on army pay for a long period. The speculative bubble of 1864 and 1865 was at its peak and hundreds of newly-organized oil companies were ready to lease or buy land wherever there was even a promise of oil. Fired up by these circumstances the Pithole Creek boom became spectacular.

Half-Acre Oil Leases

The United States Company divided its property into half-acre leases and sold more than 80 such leases at an average of $3,000. Suddenly the production of the Homestead Well jumped to 500 barrels and that of the Frazier Well to 1,200. Excitement was at fever pitch and leases doubled in price.

In the month of May, 1865, the plot for the city of Pithole was laid out on the hill, as distinguished from the well sites on the flat land of the valley. A boom town virtually sprang up overnight. The hill land had been laid out in 500 lots along some 22 streets. The two principal streets were Holmden, running north and south about a half mile, and First Street, running east and west the same distance. Their intersection was the principal corner of Pithole and was the site of the Danforth House, one of the leading hotels.

The building lots could not be bought, but only leased for three years with the privilege of removing the buildings when the lease expired or selling them to the owner of the land. If a five-year lease was desired, improvements and buildings had to be surrendered at that time. Most of the lots were leased quickly at the rate of $275 a year. When the frenzy was at its white-hot peak these leases were selling for as high as $850. The lots were just 33 feet wide.

The surrounding forest disappeared quickly as the trees were cut and sawed for Pithole's lumber. The pace of building was furious. Sometimes men entered into contracts to build a two-story building and had it completed and ready for occupancy within five days after signing the contract. This made for extremely flimsy construction. However, the leading hotels, theaters, churches and many others were of substantial frame construction. There was not one brick nor stone building erected in all of Pithole.

More Wells Come In

While the 500 lots of hillside Pithole were being rapidly covered by buildings in May and June, exciting things were happening on the flats below. On June 17 the United States Company completed its second well, south of its first one, which soon was flowing 800 barrels a day. Two days later a third well just above the original well started flowing 400 barrels. These two wells having been completed about the same time became known as Twin Wells No. 1 and No. 2 and from them the company received a daily income of at least $2,000.

In the midst of this excitement two or three storage tanks full of oil near the Frazier Well burst on June 19 and covered Pithole Creek with 2,500 barrels of oil. Two boys set a lighted match to the oil on the surface a half mile down the stream and a large fire spread quickly up the creek. But by great effort 200 men extinguished the flames.

Pithole was to be visited in its short history by dozens of other disastrous fires despite the "No Smoking" signs which were posted all over the flats.

At the end of June the wells along Pithole Creek were producing 2,000 barrels a day, or one-third the total production of the Oil Region of 6,000 barrels - the total oil production in all the world at that time.

Hundreds of teamsters were busy hauling oil from the Pithole wells to Titusville, Shaffer Farm, Miller Farm and Oil City. A "Farm" was a community, not merely the residence of one family. A long procession of empty and loaded wagons went back and forth over miserable roads. These roads became so impassable that late in July the teamsters were unwilling to take a load. Teaming almost stopped. To help keep their roads in repair, oil shippers and merchants in Titusville immediately raised a maintenance fund and every teamster contributed $1 a week to the cause. The price for hauling a barrel of oil to Miller Farm on Oil Creek, 5 1/2 miles away and the nearest railroad point, was $3 a barrel. Oil in Pithole at that time was selling for $2.75 to $3 a barrel. Thus, the cost of a barrel of Pithole oil when a refinery bought a barrel at the Miller Farm was about $6 - $3 for the oil itself and $3 for the hauling. The teamster was getting as much as the producer who had risked his money.

Sky-High Speculation

Speculation at this time was sky-high. Thousands and thousands of dollars were made and lost in selling and reselling oil leases on the Holmden Farm and other nearby farms. A high point in speculation was reached when Duncan and Prather sold the Holmden farm in July to three Titusville men for $1,300,000. This was the largest sum ever paid in the oil region for any single tract of land.

In August the Grant Well on the Holmden farm started to flow at 200 barrels, but soon increased to 1,200 barrels a day. The half-acre lot adjoining the Grant Well had been bought in the spring for $1,600. Now it sold for $16,500, the highest price on record for a half-acre lease. That same month, not far from the original Pithole well, the Pool Well came in at 300 barrels a day and jumped to 1,500 barrels a day, the largest producer at Pithole.

September Big Month

The excitement on Pithole Creek reached its peak in September when production amounted to 6,000 barrels a day. Any one of a great number of modern wells at various locations throughout the world today is capable of producing this amount alone. The Holmden Farm had 96 wells either producing or being drilled and the daily rate was 4,000 barrels. Duncan and Prather, who had taken back the Holmden farm from the three Titusville men, who had failed to meet the terms of the sale, now sold it again to other parties for $2,000,000.

Virtually this same land was bid in by the Venango County commissioners in 1878 for $4.37. The commissioners sold it to a private owner in 1886 for $83.76.

Living conditions in the town were complicated and, at times, improvised. Until December, 1865, there was no incorporated or formal local government.

Drinking Water Scarce

Drinking water at Pithole at first was scarce. Many persons profited by hauling it from distant wells to sell at 10 cents a drink. As a result the liquor business flourished. In December, 1865, a water system reservoir was competed and pipes were laid along the main street.

Restaurants, too, were booming. On the tables of the better hotels were served choice foods. Oyster bars did a flourishing business, as can still be observed by the oyster shells dug up in quantity when the sod is peeled back around what was once the rear doors of these establishments. Meals in the run-of-mine places were definitely inferior, so Pithole was generally never noted for its food.

Pithole had no sewage system. The larger hotels had dry wells nearby into which sewage was disposed. Unpleasant smells of human habitation, plus the aroma of crude oil, resulted in many visitors' first impressions of Pithole through the nose.

Four religious denominations conducted services at Pithole. The Methodist and United Presbyterian first held preaching services in an unfinished hotel. Later

the Methodists completed a church at the top of the hill in which Methodist services were held Sunday morning and Episcopalian in the evening. The United Presbyterians bought a lot and planned a church but never built it. The lot was taken over by the Roman Catholic Church for completion and put into use. St. Patrick's Church at first had a resident priest but was later supplied with one from Tidioute.

Murphy's Theater on First Street, the largest building in Pithole, had a seating capacity of 1,000. Its interior was handsomely painted and decorated and chandeliers from Tiffany's gave out light. First-class dramatic companies offering the best plays appeared there.

Gay Social Life

The social life of Pithole was gay with balls and concerts and other festivities put on by the Swordsmen's Club, who had elegantly furnished rooms. The club elected a new president every six weeks. For the families, strawberry festivals and church socials rounded out the calendar of events.

Generally speaking, despite its superficial roughness, Pithole at first was a town where good order and respect for individual rights prevailed. Strangers were surprised how little drunkenness they saw on the streets when the city was young. But toward the end of its first year ruffians and drifters moved in. Street fights increased and at least one robbery a day was committed. The police force was strengthened by the appointment of a chief, a former colonel in the Federal Army who was more than a match for the thugs and thieves. Law and order returned, and Pithole began to chase out the undesirable elements.

Pithole Was Complete

At its height Pithole had two banks, two telegraph offices, a daily newspaper, water works system, fire company, two church buildings, scores of boarding houses, grocery stores, hardware stores, machine shops, and other businesses. There were more than 50 hotels. The justly famous Morey, Chase, Bonta and Danforth were large, elegant and comfortable, furnishing their guests with all the conveniences of metropolitan hotels. The Chase House was generally regarded as the principal and best. Painted a nut-brown color, it cost $80,000, had a frontage of about 180 feet and a depth of 60 on the west side of Holmden Street. It could accommodate 200 guests and seat 100 in its dining room. In it were located the telegraph offices and, at first, the postoffice. The hotel was also general headquarters for the stage lines. One of the hotel's attractions for men was the saloon, 65 feet long and 28 feet deep, "furnished with a luxurious bar and hung with pictures." This was located on the ground floor, so guests ran no risk of tumbling from the second story piazza. Opening off the piazza were the telegraph offices and the postoffice. Sleeping quarters of the hotel were in the third story. When Pithole declined, the Chase House was moved to the boom town which next arose - Pleasantville - where it burned a few years later.

In addition to frenzied speculation, Pithole was noted for its mud. Parts of First and Holmden streets were planked, from the Duncan House to the Chase House, and plank walks with stairs on the Hillside ran from the railroad depot to the Bonta House and to the Duncan House. But elsewhere there was no paving. Letters of the day disclosed

that Pithole residents were free from mud only when they were bedded down for the night. With characteristic ingenuity residents turned mud to advantage by inventing a mud-throwing machine that saw service in extinguishing oil fires.

The Wicked Ben Hogan

Of all the individuals who inhabited Pithole, the wickedest has probably had more written about him than all the others put together. Ben Hogan- he called it Hagan much of the time- is no creature of imagination, however. He actually existed as an exceedingly strong and tough man, addicted to fast women and hard liquor. He fought in the prize ring, operated brothels, and fought and frolicked his way up and down the Oil Region. At Pithole his troupe occasionally performed at the Athenaeum. Ben himself was the star of one of the acts. Lying on the stage, he permitted an 800-pound stone to be broken on his chest.

Notorious French Kate

Ben's partner in many an episode was French Kate, one of the most notorious fancy ladies.

Late in life Ben reformed and became an evangelist, blazing a trail later to be followed by Billy Sunday.

The decline and abandonment of Pithole was every bit as swift and spectacular as its rise.

In August, 1865, a month before the town reached its pinnacle with a population of about 10,000 or more, the Homestead Well suddenly stopped flowing and had to be pumped. That same month the Grant Well and some of the others on the Holmden Farm were burned. In October fire destroyed $1,500,000 worth of oil and properties on the flats. In November the old Frazier well and Island Well quit spouting. These disheartening turns of fate were somewhat counteracted by the completion in November of a 1,000-barrel well on the Holmden Farm.

However, in January, 1866, the daily production of Pithole wells dropped sharply. In February there was a destructive fire on Holmden Street. This was followed in March by a fire on Brown Street which destroyed two livery stables, a brothel and two dwelling houses. The month of April, 1866, was noted for its many disastrous conflagrations, six major fies with much destruction.

As oil production declined and parts of the town burned, operators, speculators, businessmen and others began to depart from Pithole. All during 1866 Pithole struggled along and the daily paper continued until 1867, but at the end of that year Pithole was, for all practical purposes, dead. By 1870 only a handful of people remained and in a few years there was nothing on the site but cellar holes and odds and ends of lumber and debris to mark the site where one of the great bubbles of oil history had burst.

Its Claim to Fame

Pithole's secure and unassailable claim to historic fame is not that it was at one time a flourishing city. Rather the claim is based on the fact that at Pithole many

of the basic methods for recovering and transporting oil were developed. Most important of these innovations was the world's first commercially successful crude oil pipeline. This pipeline completely revolutionized the transportation of oil and its effects on transportation generally are growing even in modern times as a network of oil, oil products and gas pipelines knit the nation closer together. The Pithole line was built by Samuel Van Syckel from Pithole to Miller Farm, 5 1/2 miles away, over hill and valley. It was successful from the first with four pumps, but experience soon showed it would operate just as efficiently with one. Soundly designed and built, the line cut the cost of transporting a barrel of crude oil to the railroad from $3 to $1. The pipeline idea caught on immediately and soon lines were thrown from all the principal production fields of the original region to the refining centers of Titusville, Oil City and Franklin.

The trench of the Van Syckel pipeline may still be seen along almost its entire course today. When the line was operating at peak it consisted of two two-inch pipelines but both were dug up and the pipe salvaged when Pithole declined. The resulting trench was never back-filled.

Now Open to Visitors

The streets of Pithole have been recently opened to visitors and many of the sites of the principal buildings identified and marked with signs. It is difficult to realize today that so much excitement and activity once took place at this remote and isolated spot. Parts of the city will in a few years be as heavily forested as they were in the days when the city was merely the wilderness farm of Thomas Holmden.

EARLY TRANSPORTATION OF OIL

The Pond Freshet
As told by A. S. Dobbs, Superintendent of Pond Freshets

A pond freshet is a temporary rise of water in the creek for the purpose of running out boats, rafts, logs, etc. The water rises high enough to run out boats containing sometimes 500, and in some cases, 700 barrels of oil. There are usually from 150 to 250 boats on each freshet. It lasts from one to two hours, and is caused by letting the water out from seven to seventeen dams on the principle branches of the creek, so that the water will all meet together, making quite a flood upon which from 7,000 to 30,000 barrels of oil are run in boats to the river.

The shippers and boatmen, having been notified of the day upon which the freshet is to take place, begin to make preparations several days previous to it. Boats are overhauled, put in order, and then are towed, by means of horses, to the point on the creek from which they intend to start. The boats are then loaded and everything made ready for the flood which is to waft them to the much desired harbor at the mouth of the creek. About the time the freshet is expected the boatmen stand ready to loose their lines. A cool, pushing breeze is the first sign of it, and soon after comes the swirling waters. Inexperienced boatmen generally cut their boats loose upon the first rush of water. As a matter of course, their boats run ahead of the water, and get aground upon

the first ripple or shoal. The creek being very narrow and the force of the current generally swing these boats across it, a jam, and not infrequently a great loss of oil and boats ensues, just from the inconsiderate haste of a few. The experienced boatman waits at his harbor, until the water commences to recede, then cuts his line loose and trusts himself to the mercy of the swift current, and comes into port upon the highest part of the rise. The current of a first class pond freshet will run at the rate of six miles an hour. An ordinary one about four miles, and a small one two and one-half miles. If the boatman meets with no obstacle he soon anchors his craft at our wharf.

There are several points of the creek where formidable obstacles are interposed to vex the navigator. Among these are the pier at McClintock bridge, and a pier to support the machinery of a well in the middle of the creek immediately below; the Forge Dam, through which is only a narrow passage for boats; the pier of the bridge at this place, and the bar at the mouth of the creek itself. One boat getting across the creek at either of these places is apt to cause a "jam".

The boats are crushed against each other, and being generally built very light, are easily broken, and if loaded with bulk oil, the contents are poured into the creek. If in barrels, the boat sinks and barrels float off, and the owner rarely recovers them again.

Once landed at the wharves in Oil City, the boat is either unloaded, or if the water is in good boating stage, goes, after brief preparation to Pittsburgh.

Oil City is quite lively during the evening after a pond freshet. Shippers are busy paying off the boatmen, the citizens of the creek are laying in a stock of the necessities of life, and all is bustle and business. You see men dripping with the oleaginous product. The hotels are filled to repletion with these greasy men who are supplying the light for the world. Oil is the only topic of conversation, and the air is redolent with its sweet perfumery. The next morning boats are unloaded, and again towed up the creek for the next freshet, and comparative quiet again reigns in the city.

Pond freshets on Oil Creek were used extensively in 1862 and 1863. In October, 1862, more than 100 boats took part, but only a few made safe passage. In December, ice at the mouth of the creek broke loose and pounded against 350 boats containing 60,000 barrels of oil; more than 150 boats and 30,000 barrels of oil were lost.

The cost of shipping oil by barge on Oil Creek at this time varied from two to five cents a barrel, according to the distance to the Allegheny River. The toll was collected by agents passing along the creek, who collected the fees assessed according to the capacity of the barge, before the impounded waters were released. The October 29, 1863, issue of the Oil City Register contained a statement by A. S. Dobbs, Superintendent of pond freshets, on the cost of dams:

> "I here give the cost of dams and other necessary expenses of a pond fresh this year: Kingsland's dam, $200; Pierce's, $12; Stanton's, $20; Lytle's, $10; Child's, Benedict's and Rouse's, $29; Tallant's, $5; Newton's, $29; Langworthy's, $7; Tryon's, $20; Hyde Creek, $29; for superintendent, horse hire, and the services of two men to cut dams,

one on each side of the creek, $20; making a total of $383. All these dams cannot, at all times, be had, for their owners will not cut them for us. Mr. Benedict will not cut his at any price, hence we cannot get the Rouse dam, which is just above it. In dry seasons a "fresh" cannot be had every week, and if the superintendent spends a week or two extra between freshets, collecting tolls along the creek, this must be added to the expense, so that, in some cases a "fresh" actually costs $400. The same dam we now pay Mr. Kingsland $200 for, costs us in the early part of the season $55, and at no time during the summer of 1862 more than $100. Other owners of dams have raised their prices, but not in the same proportion. The rise in the price of oil, by encouraging team and rail shipments, has greatly diminished the amount of oil run out of Oil Creek, while the cost of a "pond fresh" is fully three times as great as last year."

The Oil Country Wagon-Train
as told by John J. McLaurin,
early oil historian

Before the first decade of the oil industry drew to a close, however, pond freshets were only a memory. Railroad extensions into the oil regions and pipelines from wells to shipping points reduced, too, the great number of teamsters employed in the transportation industry. John J. McLaurin has summarized conditions under which teamsters worked:

"To haul oil from inland wells to shipping-points required thousands of horses. This service originated the wagon-train of the oil country, which at its best consisted of 6,000 two-horse teams and wagons. No such transport-service was ever before seen outside of an army on a march. General M. H. Avery, a renounced cavalry-commander during the war, organized a regular army train at Pithole. Travellers in the oil regions seldom lost sight of these endless trains of wagons bearing this greasy freight to the nearest railroad or shipping point. Five to seven barrels - a barrel of oil weighed 360 pounds - taxed the strength of the stoutest team. The mud was practically bottomless. Horses sank to their breasts and wagons far above their axels. Oil dripping from innumerable barrels mixed with the dirt to keep the mass a perpetual paste, which destroyed the capillary glands and the hair of the animals. Many horses and mules had not a hair below their eyes. A long caravan of these hairless beasts gave a spectral aspect to the landscape. History records none other such roads. Many a horse fell into the water and was left to smother. If a wagon broke the load was dumped into the mud canal, or set on the bank to be taken by who ever thought it worth the trouble of stealing. Teamsters would pull down fences and drive through fields whenever possible, until the valley of oil creek was an unfathomable quagmire."

Visitors to the oil regions met continuous lines of wagon-trains hauling empty barrels and supplies to the well sites, and returning with their cargoes of crude oil. In January, 1865, J. H. A. Bone walked from Shaffer's Farm to Oil City, twelve miles distant. On the way, he noted the following:

"Here became visible the usual system of transportation adopted for oil and fuel, which is flat-boating on the creek. Four horses abreast are attached to a flat-boat, which they haul up stream, the horse taking the middle of the creek. The bed of the stream is even and covered with loose flat shale rock, the water being up to the horse's belly. An Oil Creek flat-boat generally holds from eight to one hundred barrels of oil, on which the freight up is from 70¢ to $1.00, freight on coal being in proportion. As the boats sometimes make two trips a day, the business is highly profitable, though anything but pleasant, especially to the horses."

"As we passed down the creek the weather was intensely cold, and the ice was floating down in large masses, but the unhappy horses had to wade up with their heavy loads, their bodies partially clad in icy coats of mail, and their tails mere bunches of icicles. If it is borne in mind that these horses had to be from three to four hours in this icy water, without relief or rest, and that even saddle-horses have to wade the stream several times in making the journey, the short lives and the wretched character of the live-stock in that region will not be wondered at."

The Pipe Line

The introduction of pipe lines for the transportation or crude oil created more hostility in the oil regions than any other factor. Suddenly, thousands of teamsters engaged in hauling barrels of crude oil were thrown out of employment. Some resorted to sporadic acts of violence to obstruct the operation of the lines that interfered with their traffic.

A successful attempt to transport crude oil through cast-iron pipe was made in 1862. J. M. Barrows conveyed oil from wells in the Tarr Farm one thousand feet to his refinery. That same year a bill was introduced into the Pennsylvania legislature to incorporate the Oil Creek Transportation Company, an organization "to carry oil in pipes or tubes from any point on Oil Creek to the mouth of that creek, or to any point on the Philadelphia and Erie Railroad." Despite opposition by teamsters, the bill was enacted into law. Two years later the legislature granted a charter to the Western Transportation Company, which had a line from the then famous Noble well to Miller Farm station on the Oil Creek Railroad, a distance of three miles. The previous year a pipeline two and one-half miles long connected the Empire well with the railroad terminus at Shaffer Farm. Both attempts to transport crude oil by this means proved unprofitable because of leaking joints, ruptured pipes, and vandalism from teamsters.

J. L. Hutchings came to the oil country in 1862, with a rotary pump he had patented. He proved that crude oil could be forced through pipes made leak proof at the joints and sufficiently strong to withstand the tremendous pressure and vibration from the flow. With the development of a better grade of pipe, screw joints, collar and sleeve at connections, and the use of the rotary pump to force the flow, the mechanics of carrying oil by pipe was established.

After the Pithole field was developed, Samuel Van Syckel, in August, 1865, completed a two-inch line from Pithole to Miller Farm, the railway terminus, four miles

away. Two pump stations helped force some eight hundred barrels of crude oil daily to the shipping point.

This success prompted the formation of a company to transport oil by pipe from Pithole to Oleopolis, a shipping point on the Allegheny River. The laying of the pipe was commenced in November and the first oil was run through its seven-mile length in December. This was a gravity-flow line; the continuous down-grade from a fall of three hundred and sixty feet permitted the pipe to drain itself. The line was six inches in diameter, with a capacity of seven thousand barrels.

At the same time, Henry Harley and associates extended pipe lines, using two-inch tubing of extra weight, from wells along Benninghoff Run to storage and shipping points at Shaffer's Farm, about two and one-half miles away. Teamsters cut the pipes, burned the tanks, and retarded the work seriously. The daily capacity of these lines was 2,000 barrels. They were placed in operation on March 10. Six weeks later it was estimated they were carrying one thousand five hundred barrels daily, yielding a revenue to the company of $750 per day.

Teamsters could foresee their unemployment and resorted to violence. The issue of the Titusville Morning Herold for Saturday, April 21, reported:

> "On Friday morning about 2 1/2 o'clock the teamsters attacked under the auspices of a formidable mob, numbering between seventy-five and one hundred men, armed with revolvers. They rushed down from the timber and underbrush at the hillside, and before reaching the tanks halted, when the ringleader notified the watchmen that they intended to destroy the tanks and called upon them to disperse; or they would be shot down. The watchmen hesitated, but made no reply. The mob then fired upon them, but without effect. The watchmen retreated and discharged their own revolvers at the mob, and it is supposed with effect. One man was heard to exclaim, "I am shot."
>
> "Another of the mob was seen to throw a fireball into one of the tanks, and in an instant the flames burst forth, communicating of course to the adjacent tanks. There were five in all, but fortunately the oil had been drawn down the previous day, and there were only 800 barrels of oil in store."

Owners of pipe lines and storage facilities quickly took action to protect their property. In addition to the employment of watchmen at storage sites and along the lines, hired detectives who joined the malcontents. Ringleaders were arrested and mob rule overthrown. By the end of the first decade of the oil industry, wells were connected by pipe directly with storage tanks at the pumping stations, and whenever new fields were opened, pipe lines were extended to take care of the production.

The Oil Tank and Railroad Car

Storage facilities and railroad cars to transport crude oil likewise improved in quality and capacity during this period. At the beginning of the period, storage other than dug pits consisted of wooden tanks constructed to hold a 200- and later a 1200- barrel

capacity. By the summer of 1866, however, wooden tanks were rapidly being replaced by those of larger capacity built of iron. A 10,000-barrel tank was built at Petroleum Center in June; several were under construction at Oil City, the largest with a capacity of 14,000 barrels.

It was estimated that an iron tank of 12,000-barrel capacity was not so expensive as twelve wooden ones of 1,000-barrel capacity, and served as added protection against loss by fire.

Although the tanks were not fireproof - they were more fireproof and practical than wooden tanks - they came into common use in the oil industry. By July, when daily oil production was estimated to be 11,000 barrels, the total capacity of iron tanks did not exceed the amount of oil recovered in a week, by the end of the year, storage capacity in iron tanks was estimated to exceed a half-million barrels. One company alone was building a 10,000-barrel tank every twenty days. By the end of the first decade of the oil industry, tanks with storage capacity of 20,000 to 30,000 barrels were not uncommon.

The first oil shipped by rail was contained in wooden casks or barrels. Leakage caused much loss. A flat car could be loaded with sixty barrels, set end on end. During the summer of 1865, Amos Densmore of the shipping firm of Densmore, Watson and Company, conceived the idea of shipping oil in bulk. In September, two cars of the Atlantic and Great Western Railroad were each equipped with two wooden tanks to hold the oil. Each car carried 84 to 90 barrels of bulk oil at the rate normally charged for 60 barrels. This first shipment, from Miller Farm on Oil Creek to New York, proved successful; other cars were equipped for the full shipment of oil, and by April of the following year it was estimated there were 400 tank cars in use, capable of carrying 32,000 barrels of oil which not only saved capital formerly tied up in barrels but saved on carrying charges. The freight rate for an 80-barrel car was the same as that formerly charged for transporting 60 barrels.

In 1869, one of the principle shippers of crude oil, the Empire Transportation Company, first put into use iron-boiler tank cars of 80-barrel capacity. Knowledge of loss of contents due to expansion in wooden tank cars led to the adoption of a dome on each car to compensate for the expansion factor. Experiments proved this should be a ratio of one gallon per barrel of tank capacity; therefore, a dome was adopted of 80-gallon capacity.

The Oil Scout

The professional "oil scout" first became prominent at Cherry Grove, Warren County. Here the "Mystery" well drilled on Lot 646 is credited with the discovery of the Cherry Grove pool. The scouts, among whom were S. B. Hughes, J. C. Tennent and P. C. Boyle, were kept busy scouting the rapid development of this exceptionally productive oil field. One night, while scouting the Shannon well on the Cooper tract, as the scouts were attempting to crawl near the well a twig snapped and the guard fired a shot which grazed the ear of a scout. This well was drilled in on July 21, 1882, and was plugged and guarded so no one knew if it was a dry hole or a producer. The oil trade staggered under the adverse fear of the mystery until September 14, when the plugs were drilled out and the scouts reported the well dry, which steadied the market.

Prior to this time the newspapers of the region had been depended upon to furnish information concerning new wells and new fields, but with the growth of wild speculation in oil as the Bradford field opened, the market was adversely or favorably affected by rumors and "mystery" wells. In order to protect themselves the leading interest in the oil trade employed trained men to watch wells and report daily on conditions. Oil scouts prowled at night and spied on "mystery" wells, watched hotels and livery stables to observe all who came or went, listened in telegraph offices and ciphered messages being sent or received, crept inside the guard lines to gauge a well, and resorted to all sorts of measures to secure accurate information for their employers.

MONTHLY AVERAGE PRICE OF BARREL OF CRUDE OIL AT WELL

	1860	1861	1862	1863	1864	1865
January	$19.25	$1.00	$ .10	$2.25	$4.00	$ 8.25
February	18.00	1.00	.15	2.50	4.37 1/2	7.50
March	12.62 1/2	1.00	.22 1/2	2.62 1/2	5.50	6.00
April	11.00	.62 1/2	.50	2.87 1/2	6.56	6.00
May	10.00	.50	.85	2.87 1/2	6.87 1/2	7.37 1/2
June	9.50	.50	1.00	3.00	9.50	5.62 1/2
July	8.62 1/2	.50	1.25	3.25	12.12 1/2	5.12 1/2
August	7.50	.25	1.25	3.37 1/2	10.12 1/2	4.62 1/2
September	6.62 1/2	.20	1.25	3.50	8.87 1/2	6.75
October	5.50	.10	1.75	3.75	7.75	8.12 1/2
November	3.75	.10	2.00	3.85	10.00	7.25
December	2.75	.10	2.00	3.95	11.00	6.50

SUMMARY - MINING FOR OIL IN PENNSYLVANIA

	Mine at -	Original farm or oil lease -	Name of operating company -	Final Depth of Mine -	In charge of operations -	Results -
I	Tarentum, Allegheny County.	Humes farm. Donnelly, then Peterson & Irwin property.	Tarentum Oil, Salt & Coal Co.	220'	A. C. Ferris	Abandoned due to gas and salt water seepage.
II	Tidioute, Warren County. Started 1864.	Shadrach Tipton farm, later Wm. Cohell farm	Enterprise Mining & Boring Co.	165'	Hart	Halted due to accident in 1865.
III	Petroleum Centre, Venango County. Started May, 1865.	Hayes farm later Dalsell Petroleum Co.	Petroleum Shaft & Mining Co.	90'	D. W. Davis	Halted due to lack of funds, 1886.

SUMMARY - MINING FOR OIL IN PENNSYLVANIA (con't)

	Mine at -	Original farm or oil lease -	Name of operating company -	Final Depth of Mine -	In charge of operations -	Results -
IV	Franklin, Venango County. Started July, 1942.	D. W. Grant lease, 3 miles north Franklin; Upper Two Mile Run area.	Venango Development Corp.	429'	Leo Ranney	Producing 1959.
V	Pioneer, Venango County. Started 1944.	On Bull Run, east side of Oil Creek at Pioneer.	Northern Ordnance Co.	82'	Westmark	Halted 1944

STRATIGRAPHY

Exposed Rocks

Pennsylvanian System

Pottsville Series. A heavy sandstone, occasionally pebbly, caps a few of the higher hills. Good exposures of it are rare, and it is usually seen as large, loose blocks and rock cities. The exact position of its base is, therefore, impossible to determine, but it appears to be from 250 to 300 feet above the base of the Corry sandstone. It is not certain whether this sandstone is the equivalent of the Olean conglomerate which is well developed to the northeast, or the Connoquenessing sandstone, which is well developed to the southwest. It is not always well developed and recognizable. At Pleasantville and east of Pithole a thin coal seam is present about 400 feet above the Corry sandstone.

Mississippian System

Shenango Group. A series of sandstones and shales with some calcareous sandstone and sandy shale occupies about 120 feet of section below the Pottsville. In the upper part there is a rather persistent sandstone bed, 30 to 40 feet thick, whose top is about 240 feet above the Corry sandstone. It is not well exposed, but was noted in two of the sampled wells. At the base of the series is a widespread and frequently exposed bed of sandstone about 30 feet thick, whose base lies from 130 to 150 feet above the Corry sandstone. It is generally a coarse quartz sandstone, and is noticeably pebbly in the northwest corner of the area. It usually contains numerous ferruginous concretions and cavities. Well cuttings show that it is usually underlain, either immediately or 10 feet below its base, by a fine calcareous sandstone bed. This sandstone has generally been considered to be the Shenango sandstone by previous workers in the district, although it has not been definitely traced to the Shenango in its type area.

Cuyahoga Group. From 130 to 150 feet above the Corry are dark gray shales, gray sandy shales, some reddish-brown shales, and fine sandstones comprising the Meadville, Sharpsville and Orangeville formations. The sandstones are frequently calcareous, but do not seem to occupy any constant position, and it was not found possible to divide the group into the subdivisions proposed by I. C. White for the Meadville district.

Corry Formation. The Corry sandstone is the most persistent of the sandstones of this district, and is the only one suitable for use as a key horizon. It is a fine, rather massive, but occasionally platy sandstone, pure white or yellowish white on a fresh surface, and characteristically weathers pasty or chalky white. It is harder and more compact than the other sandstones.

Within the Titusville area the Corry generally consists of three members. The upper sandstone member is usually the more massive, and is from 8 to 15 feet thick. The middle member is shale with thin sandy shale and platy sandstone beds, and ranges from 5 to 10 feet in thickness. The lower member is fine, hard, platy sandstone, 10 to 15 feet thick. Certain beds are richly fossiliferous and frequently calcareous. The fauna has been described by Kenneth E. Caster.

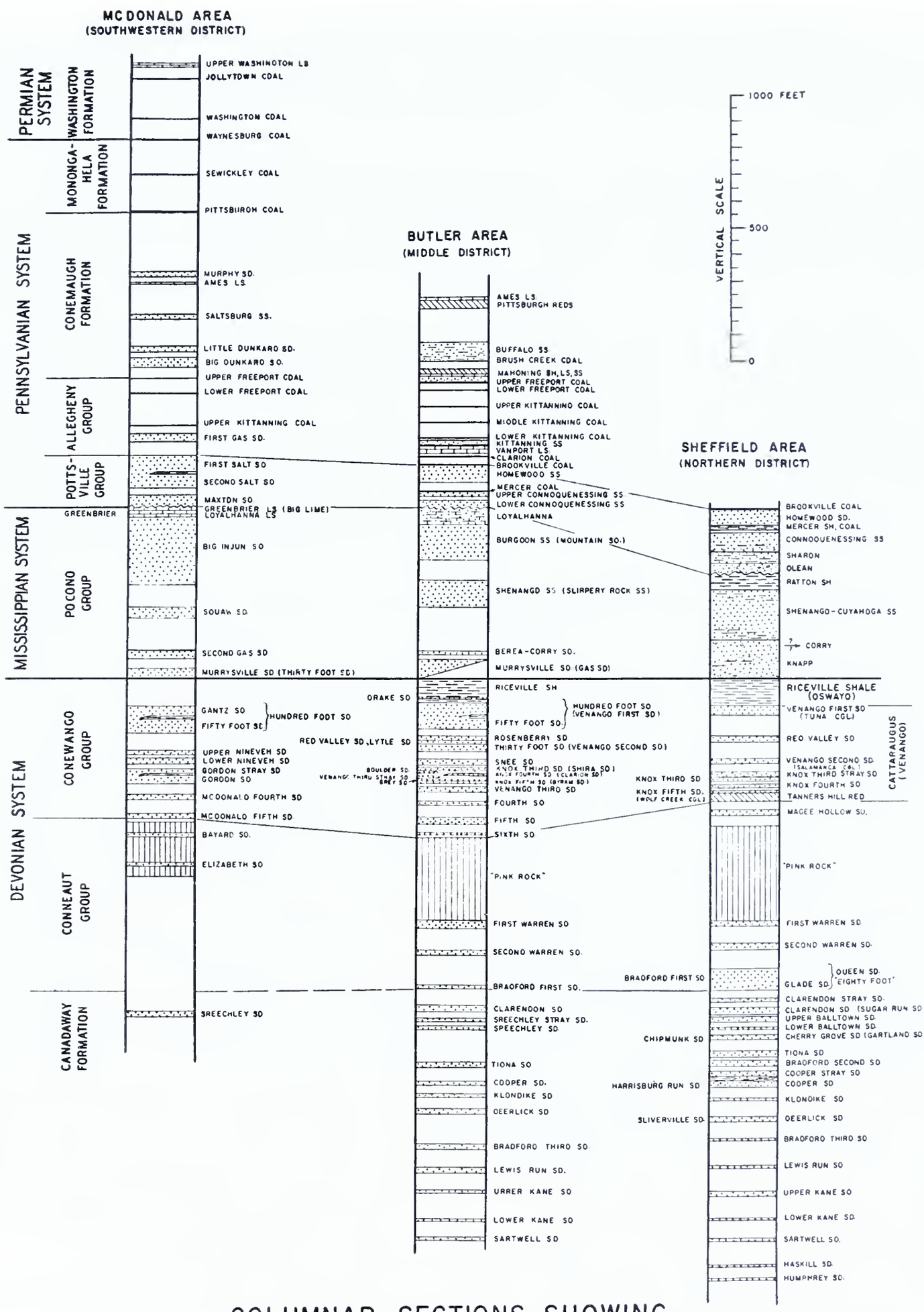
Cussewago Formation. The Cussewago Formation is well exposed along Oil Creek Valley. It consists of 80 to 100 feet of alternating beds of very fine, light-gray, flaggy sandstone, and dark-gray shale and sandy shale. A faint reddish color is occasionally noted in the shales. The sandstones are frequently fossiliferous and some contain abundant crinoid fragments. Some beds are quitecalcareous.

The Cussewago is probably the equivalent of the Knapp Formation of the Bradford area, as pointed out by Caster and others. Caster has subdivided the Cussewago and named the various members from localities near Kane, Bradford, Tidioute, and Meadville. It is very doubtful whether such a general subdivision is either wise or appropriate, for the formation changes character from a coarse conglomeratic series near Bradford to an extremely fine, silty sandstone and shale series in Crawford County. It is not possible to correlate the individual sandstone beds from drill cuttings throughout the Titusville area. However, electric logs of several wells show that there are three prominent sandstone beds which are widespread in the southern part of the quadrangle. Their tops lie 40, 55, 75 feet below the base of the Corry sandstone.

A calcareous bed is sometimes, but not always, noticed about 100 to 120 feet below the base of the Corry. In the Dennis Run section it is abundantly fossiliferous, and is called the Marvin Creek zone by Caster. At Riceville a limestone bed 50 feet below the Corry was called Marvin Creek by Caster. However, it was relocated in the new road cuts 25 feet below the Corry and it is doubtful if it is equivalent to the Marvin Creek. The fact that fossiliferous and calcareous beds are common throughout the Cussewago formation makes the identification and naming of any one of them hazardous. Dennis Run is near Tidioute, Marvin Creek near Smethport, and Riceville is in Bloomfield Township, Crawford County.

Devonian System

Riceville shale. Shales with occasional thin silty sandstone beds, 90 to 100 feet thick, extend from 80 to 170 feet below the Corry sandstone. These shales are



COLUMNAR SECTIONS SHOWING STRATIGRAPHIC POSITIONS OF OIL AND GAS SANDS OF WESTERN PENNSYLVANIA

JOHN M BERGSTEN, 1957

Figure 1

characteristically reddish, especially in their lower part, and are generally noticed but not recorded by the drillers. The reddish color is noticeable even in weathered outcrops near Tidioute.

Examinations of the outcrops, drill cuttings, and electric logs indicate that this formation is a stratigraphic unit, distinguishable from the sandy Cussewago above the First Sand Formation below. It corresponds exactly in thickness and position with the Riceville shale as defined by I. C. White, although it is not included in his Riceville section.

Caster's suggestion that this member be called the Oswayo shale seems unfortunate. The Oswayo of the Bradford district is distinguished from the underlying Cattaraugus principally on the basis of its greenish and gray color, and both Oswayo and Cattaraugus are names of facies. The Riceville shale is very probably the equivalent of the upper part of the Oswayo of the type region, but much more detailed work must be done before the Oswayo-Cattaraugus contact can be identified in the Titusville district. Bright red strata are often associated with the Second Sand Formation in the Venango field, and these rocks are undoubtedly equivalent to some part of the Cattaraugus.

There is no evidence in the Titusville quadrangle for a disconformity at the top of the Riceville shale, but Caster's suggestion that it marks the top of the Devonian System seems reasonable.

Venango Group
First Sand Formation

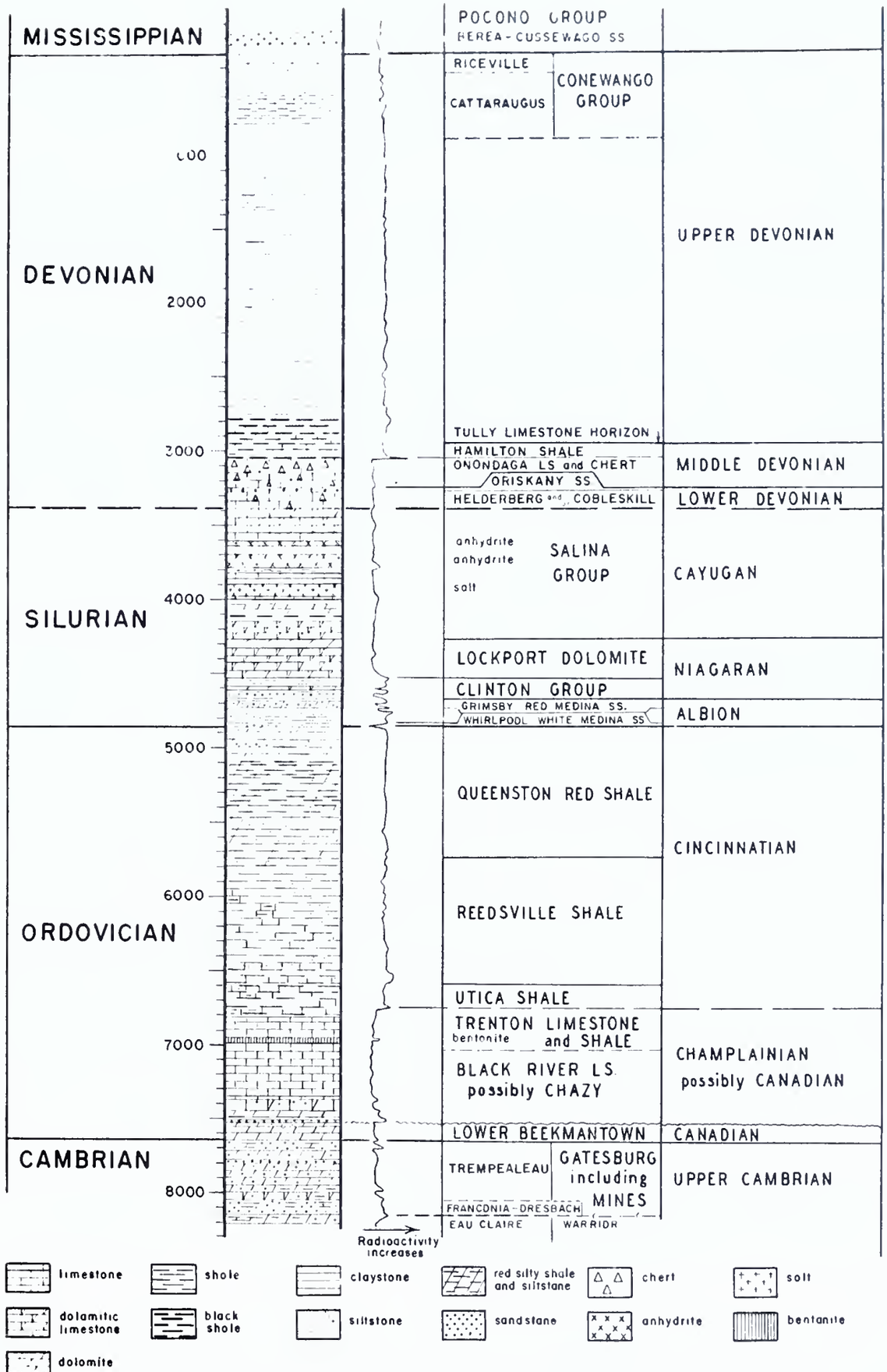
The First Sand Formation ranges between 50 and 130 feet thick. Its top lies about 200 feet below the Corry sandstone. It is predominantly a formation of fine, hard, white, locally calcareous sandstones, with beds of gray to reddish-purple shale, and light-gray sandy shale. Pebbly beds are common in the sandstones. The First Sand Formation is present throughout the entire area, but is not generally reported by the drillers except where gas, oil, or abundant water is found in it.

In the western part of the quadrangle this formation is 50 to 60 feet thick. Oil and gas are found in a few places in the lower 25 feet. The sand here is similar to the First sand of the Franklin area. Toward the southeast the formation thickens by the addition of sandy beds to the top and especially to the bottom. Apparently the underlying Saegerstown shale becomes sandy, and contains the Red Valley sand southeast of a diagonal drawn from the northeast to the southwest corner of the area.

The sand beds of the First Sand Formation in the Venango district are irregular in stratigraphic position and usually of small and irregular area. It has been found impossible to correlate any unit over distances of more than a mile or so, except in a continuously productive area.

In the southwestern part of the area several oil pools occur in well developed sands near the base of the formation aligned along a rather definite trend.

The First sand is an important source of oil in the Titusville and Franklin areas, where the sand bodies range up to 60 feet in thickness, and occupy rather large areas. In



COLUMNAR SECTION AND GAMMA RAY LOG
WESTERN PENNSYLVANIA
OBTAINED IN THE EMMA MC KNIGHT WELL NO.1
MELBEN OIL COMPANY
PYMATUNING TOWNSHIP, MERCER COUNTY, PA.

WALTER R WAGNER, 1957

Figure 2

the northwest parts of the Titusville and Townville quadrangles there are no commercially productive wells in the First sand. It there contains fresh water, which gained access to the sand through the glacial valleys that penetrate it. From the rather meager data available, it appears that the sand in that area may be well developed and continuous, and there may be a long bar of good sand similar to that of the Second sand.

Cross trends are quite noticeable in the First sand, especially in the Titusville area, where separate pools show a tendency to line up in a northwest-southeast direction. On the whole, however, the First sand is characterized by its irregularity, and the fact that the most porous streaks may lie in almost any direction, or be curved.

Red Valley Sand. In the southeast part of the Oil City quadrangle, at about 280 feet below the Corry sandstone, 12 pools produce oil from a sand that occupies a position in the upper part of the Saegerstown shale, as the latter is developed in the western part of the quadrangle. This sand is usually called Red Valley by the drillers, after the southwesternmost pool. It correlates with the Amber sand of the Franklin quadrangle, and the White sand of the Tidioute quadrangle.

Saegerstown Shale

Below the First Sand Formation in this region is a section of gray shale with a few thin sandy shale beds. It is about 40 feet thick. In the southeast part of the Oil City quadrangle the Red Valley sand occupies the middle of this formation. It seems likely that the Saegerstown shale changes its facies to that of the First sand in a southeasterly direction and may therefore properly be considered absent in the southeast half of the Oil City quadrangle, except for about 5 and 10 feet of shale that separates the Red Valley from the horizon of the Lytle Sand.

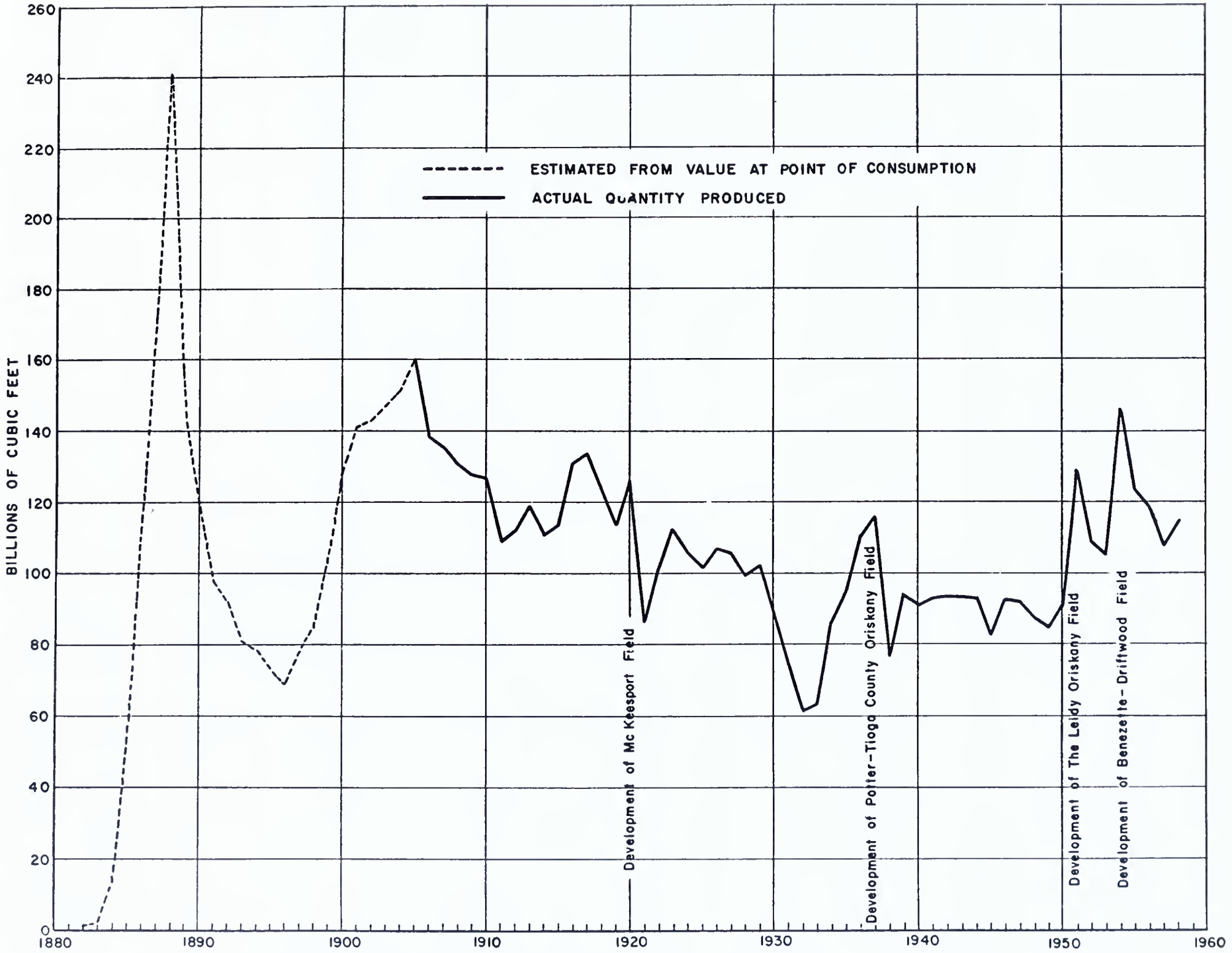
Lytle Sand

The Lytle Sand, whose top lies approximately 320 feet below the Corry sandstone, is well developed in a belt about two miles wide in the northern part of the Oil City quadrangle. The northwestern edge of this belt coincides closely with the road between Plumer and Oil City. Northwest of this line the sand is completely absent, and the Saegerstown shale runs directly into the Amity shale below. Where well developed the Lytle Sand is a uniform, fine-grained light-gray sand, unbroken by shale beds. Pebble beds are sparsely present at the top or bottom.

East of Pithole Creek the sand is present, but is fine-grained and hard, except for certain irregular areas. At one of these, on upper Pine Run, the sand is coarse and pebbly in an area of 5 to 10 acres. East of Stewart Run the sand is not recognizable as a geological unit.

South of Allegheny River the Lytle Sand is thin and shaly. It is doubtfully recognizable as a thin pebbly horizon in two sampled wells in the eastern part of the quadrangle. It may be present, but is not recognizable, in the southwestern part of the quadrangle.

The Lytle Sand is present and well developed from Allegheny River northwards to Tidioute in a belt about two miles wide. The northwest edge of this belt is smooth and



ANNUAL PRODUCTION OF NATURAL GAS IN PENNSYLVANIA

Figure 3

the southeast edge is irregular, the sand probably continuing to the southeast but becoming hard and shaly.

The Lytle Sand was named for the Lytle farm, near Pithole, where it was first productive. It is called the Red Valley sand in the Oil City quadrangle, the Lytle or Red Valley sand in the Titusville quadrangle, and the Second sand in the Tidioute quadrangle.

Below the Lytle Sand is an interval of about 30 feet that is predominantly shaly.

Petrography of the Venango Sands

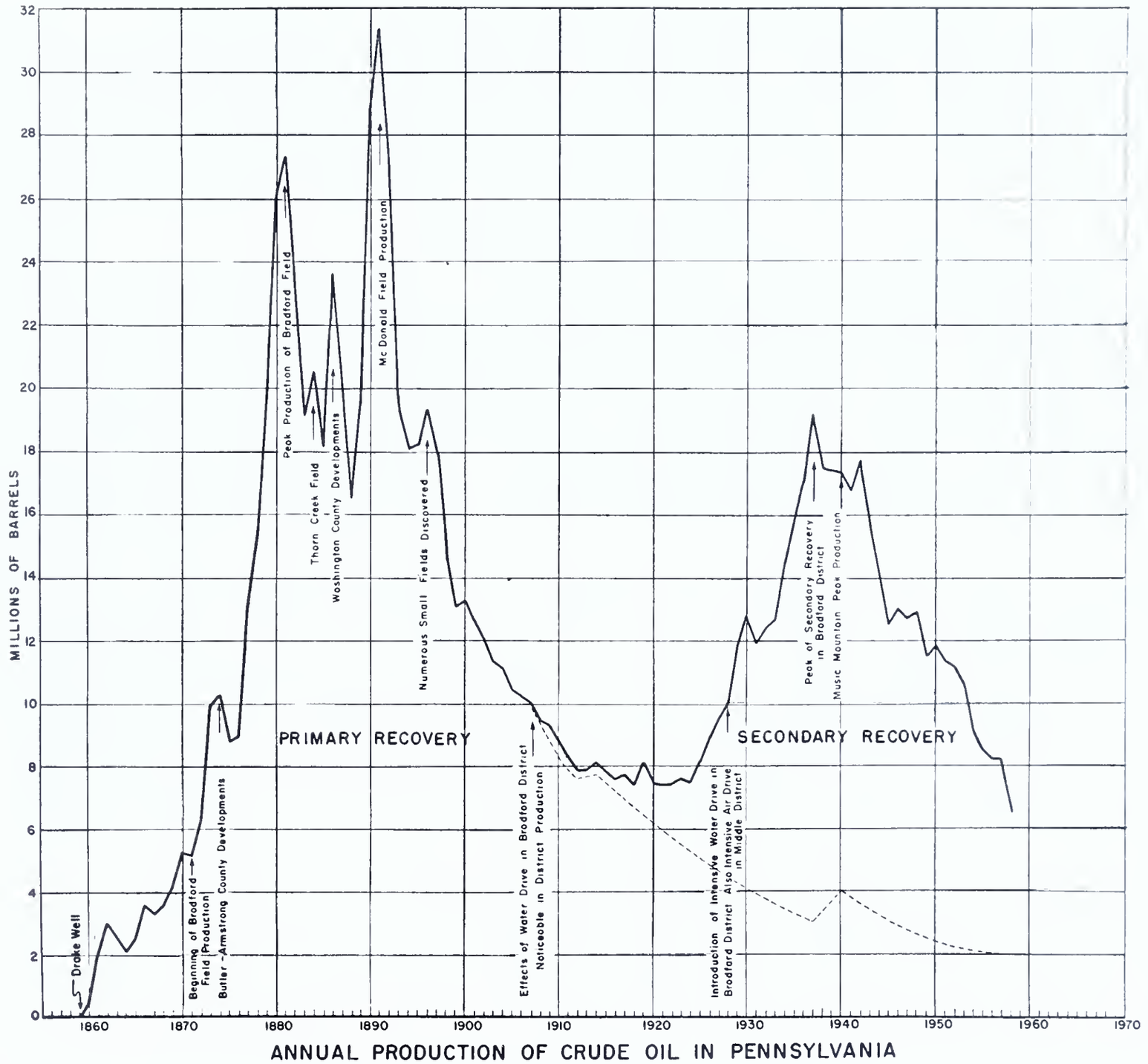
Although the characteristic shape, trend, and habits of the Venango sands are different in the three formations into which the group may be divided, certain features are common to all of them.

With few exceptions, the west or northwest edge of the NE-SW trending bodies is smooth and regular, and the sand thins and disappears abruptly northwest of this edge. Within one or two miles southeast of the edge, the sands are coarsest and most porous. Farther southeast the sands become fine, impermeable, and contain more shale. This is also ture of the Speechley sand, which is not in the Venango Group.

Pebbles are almost invariably present at the top of the sand. As a rule there is a "cap-rock" one to two feet thick at the top of producing sands, consisting of quartz pebbles firmly cemented in an impermeable shaly matrix. Within the sand body, pebbles or conglomerate beds are more common in the upper part of the sand than at the base. A curious rock that is present in certain beds in all sands, consists of small lenses and lumps of sand in shale, in irregular positions as if kneaded. Small lenses and lumps of shale are frequently contained in the sands. Paper-thin bedding planes consisting of black shaly material with flakes of muscovite mica are common even in the more massive sandstone beds. They are apparently of small lateral extent, but effectively reduce the vertical permeability of the sandstone to practically zero. Pebbly beds are sometimes found at the bottom of the sands, but not as often as at the top.

The Venango sands consist predominantly of clear quartz. Feldspars are rare but muscovite is abundant. Heavy minerals are scarce and show few species. Zircon and tourmaline constitute the bulk of the heavy minerals. The tourmalines are of various colors and some show euhedral outgrowths on rounded grains. Barite is locally common and is undoubtedly authigenic. Rutile, anatase, brookite, ilmenite, siderite, and pyrite are common. Garnet, chlorite, and zoisite are rare. Andalusite, sillimanite, staurolite, and cyanite are extremely rare or absent. The striking features of the detrital heavy-mineral suite are its constance in percentage and its lack of the less resistant minerals. These indicate that the source of the sands was essentially the same and that this source consisted almost entirely of sedimentary rocks or of a sedimentary series which had been only slightly metamorphosed.

The Venango sands are well cemented by secondary silica. Thin sections show secondary silica outgrowths which partake of the crystal axes of the original quartz grains, and which join the adjacent grains in an irregular manner. Most of the fractures and small cavities are filled with calcite. As a rule, the finer the grain size, the more



ANNUAL PRODUCTION OF CRUDE OIL IN PENNSYLVANIA

Figure 4

complete is the secondary silica cementation. Most of the coarser pebble rocks are loose and friable, except where the pebbles are in a fine sand, clay, or ferruginous matrix. In some coarse pebble rocks, small, loose, perfectly euhedral quartz crystals are common.

Oil and gas in commercial quanities are found only where there are porous and permeable sands. The converse is almost equally true in this district - that where porous and permeable sands exist, oil or gas is present in commercial quantities provided that the sand body is sealed and is sufficiently thick. Where oil is not present, the sand is tight. The comparatively few exceptions to this rule are in the First sand or at structurally low locations in the Second sand.

Origin of the Venango Sands

General consideration. The features of the sands described above leave little doubt that the Venango sands were deposited under shallow water in a marine but near-shore environment. During the Upper Devonian in the eastern and central parts of Pennsylvania the Catskill red beds were being deposited under continental conditions. Fine sands and muds were spread out over a wide, flat plain, probably in some respects comparable to a delta. However, there is no evidence of any one river; probably the deltas of several rivers coalesced. To the west, in Ohio, dark gray marine shales were being deposited. The shore line, therefore, must have been somewhere in the vicinity of the Venango oil district.

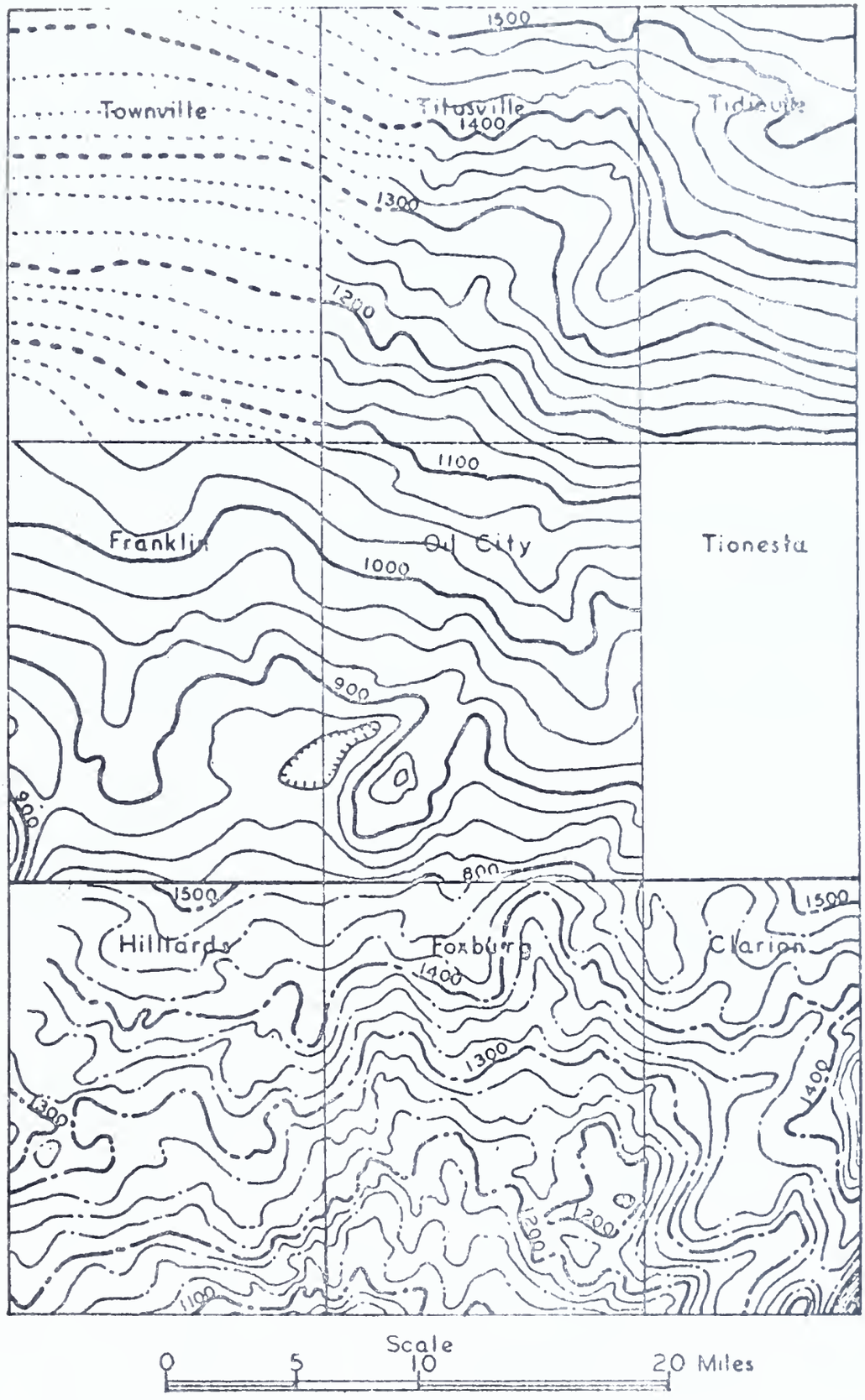
The concentration of coarse and permeable sands in narrow bars, all of which trend roughly northeast, while marine shales are found to the west and fine sands and muds, some unquestionably continental, are found to the east, suggests that the sand bars are off-shore bars similar to those of many present-day coast lines. Such bars are beautifully developed along the east coast of the United States, and along the north and west coasts of the Gulf of Mexico. Their mode of origin has been thoroughly studied by Johnson. He considers them to be formed principally by wave action, although the effect of longshore currents is noticeable, and sometimes important. They are particularly characteristic of shore lines of emergence.

Bass, in a detailed and masterful study, came to the conclusion that the "shoe-string" oil sands of southeastern Kansas were formed as offshore bars. It was suggested by Brewer that certain sands of the Venango group in southwestern Pennsylvania may be sand bars formed by wave action, such as offshore bars, spits, and tombolos.

The lithology of the sands where they are productive of oil is very similar to that of modern beach sands. They are well sorted, and contain flat pebbles, up to an inch but usually less than 1/2 inch in diameter, which may be either in separate beds or scattered through the sand. The pebbles are more abundant on the top than near the bottom of the sand body.

The shape of many of the sand bodies is also similar to that of offshore bar and beach deposits. They are usually elongated, with a smooth western edge. They are thicker and coarser near the smooth edge, and become thin, fine, and shaly to the east. To the west there is usually nothing but marine shale and sandy shale, with often a thin bed of fine shaly sandstone at the horizon of the sand body. To the east the sands are often present for a few miles as thin, fine, shaly sands, in some places thickening

STRUCTURE MAP



Surface structure of the Venango district.

irregularly to form local coarse spots. The sands of the Second Sand Formation pass eastward almost immediately into continental type sediments, often red. The sands of the other formations pass eastward into interbedded dark gray sands and shales for as far as they have been studied, about 10 miles. It is known that 20 to 30 miles to the east of the whole Venango group is a reddish series of the Catskill facies.

The general geology of Pennsylvania shows that during the whole of the Upper Devonian the shore line gradually retreated, since the continental type of deposition extends farther and farther west in higher and higher beds. This retreat of the shore was probably due mainly to the encroachment of the deposits from the east, rather than any uplift of the land near the shore line. There is no indication of periods of erosion of any magnitude in central Pennsylvania, where the Upper Devonian is much thicker than it is in western Pennsylvania. There is no reason to believe, however, that the retrogression of the shore line was absolutely steady and continuous. There probably were oscillations back and forth, and quite likely periods of uplift during which some of the Catskill-type continental deposits were subjected to erosion and redeposition farther west. These oscillations only interrupted the long-term retrogression of the shore line.

The oil sands undoubtedly represent deposits of sand and gravel concentrated by wave action at or near the shore line at different positions in its irregular progress. They show many irregularities and features, however, that make them rather complicated. They are not simply to be compared to the offshore bars of the Atlantic coast. There are different types and habits of form and lithology in bars at or near the same horizon, and the bars of the different "formations" show considerable differences. It is impossible to understand and explain all their features, even with the large amount of data available for study.

The bars of the Venango sands cannot be strictly comparable to those of the east coast of the United States, because that coast is not only a shore line of emergence, but land back of the shore is undergoing active erosion. The bars of the Mississippi Delta are perhaps more analogous to those of the Venango group. The Venango sands, however, do not exhibit any projection of the sediments in a long seaward peninsula as does the mouth of the Mississippi. Rather, they show a very smooth and long, unbroken sweep of coast line. The Mississippi Delta, however, is, according to Fenneman, ". . . . apparently unique. The form of its seaward margin is determined more by the river and less by the waves than that of most great deltas". Perhaps the delta of the Rhine, built as it is into a shallow and limited epicontinental sea, is more comparable to the Venango type of deposition. A very interesting feature of the North Sea off the Rhine Delta is the presence of submarine sand ridges, which have been extensively studied by the Dutch. There are bars, many miles long and often a mile or more wide, lying on the sea bottom in 60 to 70 feet of water. They are often 30 to 50 feet high, and their tops are thrown into waves, which are 10 to 30 feet high, and 1,000 to 2,000 feet from crest to crest. These bodies resemble the sand bodies of the Third Stray sand. If such undersea sand ridges are represented in the Venango series, an interesting conclusion follows: that they may be temporally equivalent to shore-line bars 50 feet or more stratigraphically higher.

FIELD TRIP B
Saturday, May 16

Bedrock and Oil Geology of Northwestern Pennsylvania and the great Oildorado

Departure: 8:00 A. M. by bus from Colonel Drake Hotel
Topographic maps: Titusville, Tidioute, Tionesta, and Oil City quadrangles (1:62,500)

ITINERARY

POI	Mileage	
x	0.0	Colonel Drake Hotel, Titusville, Pa: Buses will assemble at North Franklin St. entrance of Hotel and head north.
	0.1	Turn left at first traffic light onto West Walnut Street.
	0.6	Turn right onto Route 8 at junction of West Walnut Street and Route 8.
Stop I	1.1	Woodlawn Cemetery: (Buses will deposit passengers at gate to cemetery, proceed to turn around, and pick up passengers on opposite side of street). The first movement to honor Colonel Edwin L. Drake and memorialize his famous well realized its goal on Oct. 4, 1901, when a magnificent monument to the memory of Colonel Drake, the generous gift of Mr. Henry H. Rogers, was unveiled and dedicated in this cemetery. Within a short time the body of Colonel Drake was exhumed at Bethlehem, Pennsylvania, and removed to this cemetery.

The terminal moraine of the Wisconsin ice sheet is present about two miles northwest of Titusville. Previous to the advance of the Wisconsin ice sheet the drainage of this part of northwestern Pennsylvania was north westerly towards what is now Lake Erie. Oil Creek flowed north instead of south as at present, and its headwaters probably were near Titusville. During the maximum advance of the ice sheet tongues of ice may have occupied the old preglacial valley of Oil Creek and Pine Creek as far south as Titusville. The ice deepened the valleys and probably also straightened and otherwise modified them.

While the ice sheet occupied the area to the north, it was impossible for the water to flow out in that direction. Furthermore, the melting of vast quantities of ice at the southern edge of the glacier provided abnormally large quantities of water to be disposed of. The upper valleys of the north-flowing streams were thus damned up, and became short-lived lakes. The waters had to seek exit over the crests of the divides to the south. The large amounts of water quickly cut deep gorges. The valley of Oil Creek below Titusville is an excellent example of such a gorge. The old divide probably was near Boughton, and from there to Oil City the water followed and greatly deepened the channel of an old water course. The small side streams probably at first were unable to

POI Mileage

deepen their channels as fast as the main bed was deepened, and were left hanging, spilling their waters down over waterfalls. Since the retreat of the ice, most of them have cut back and smoothed out the waterfalls, but one stream on the west side of Oil Creek one mile above Miller Farm is still a hanging valley with waterfalls over hard sandston ledges.

Evidence of the lake that occupied Oil Creek Valley can be seen in the terraced gravel banks on the hillsides south and east of East Titusville, and the large gravel banks on the main road one mile south of Titusville. The valleys of Oil Creek, north of Titusville, and of Caldwell Creek, were filled with debris, principally gravel, sand and clay. On Watson Flats, east of Titusville, the rock floor lies about 100 feet below the present valley surface, the original valley being filled to that height with soft clay and gravel.

The rocks outcropping on the hillsides are of the Pocono Group, Mississippian age. We will continue traveling in the glacial filled valley to POI -1H. As we climb the hill we will be crossing the Pocono rocks until reaching POI - 1J. The Corry sandstone, which is a very useful key bed in northwestern Pennsylvania, outcrops about 90 feet above the floor of the valley of Oil Creek and Pine Creek.

1.8 After reloading, buses will return to junction of West Walnut Street and Route 8 and turn left onto West Walnut Street.

1 A 2.6 Ida M. Tarbell's Home:

Ida M. Tarbell noted oil historian, biographer of Lincoln, and journalist lived in this house about six years. She was graduated from the Titusville High School in 1875. The Bonta House, a hotel at Pithole, was erected at a cost of $80,000 and was sold for $16.00. The lumber was used to build the Tarbell house.

3.0 Stop sign:

Junction of East Walnut Street and Route 27. Titusville's new recreation area on left. Continue east on Route 27.

1 B 3.3 Early Refinery:

The first refinery in the Oil Creek Region for crude petroleum was built nearby in 1860. The first run of oil was made in 1861. Oil was first refined at Pittsburgh about 1854 by Samuel Kier. The toll gate for the double lane plank road between Titusville and Pithole was located near this spot. The oil from Pithole was hauled to Titusville in barrels transported by teams over this plank road. From here to Pleasantville we will be following this old road. Read transportation story in front of log book.

I C 3.5 Refinery site:

Site of City Service Refinery now abandoned. Buildings used by Trans Penn Oil Company for blending of refined oils. Office building

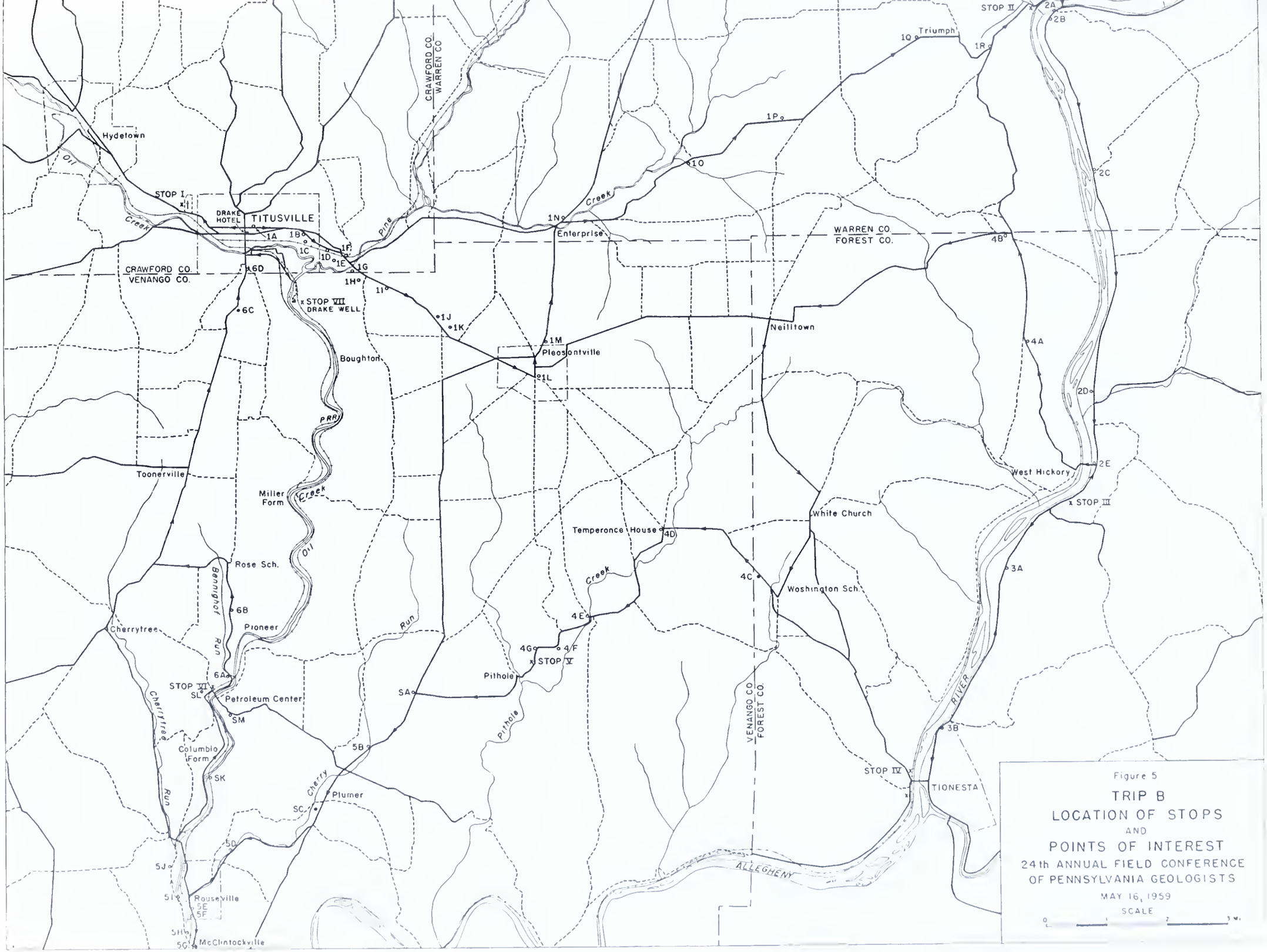


Figure 5

TRIP B

LOCATION OF STOPS

AND

POINTS OF INTEREST

24th ANNUAL FIELD CONFERENCE

OF PENNSYLVANIA GEOLOGISTS

MAY 16, 1959

SCALE

POI Mileage

is now production office for Quaker State Oil Ref. Corp's. oil leases in the area. For the next mile we will be traveling along the glacial filled valley of Pine Creek. Fresh water wells in this glacial fill produce up to 1,000 gals. per minute. Titusville's fresh water supply comes from wells in the glacial fill. The rock floor of this valley lies about 100 feet below the present valley surface, the original valley being filled to that height with soft clay and gravel.

1 D 3.9 Grasshopper City:

It was a surprise when it was announced that on the 6th day of April, 1877, a pit 15 feet deep had been dug on Watson's flats which was yielding by a common hand-pump thirty barrels of oil per day, and this within a few rods of territory which had been thoroughly operated upon ten or fifteen years before. From 1,000 to 1,500 visitors came to see this sight.

More than 100 oil wells had been sunk in the usual way since 1859, and by the length of drive pipe required to reach the bedrock, they conclusively demonstrate the fact that the channel of the old stream, once flowing between these hills, was a hundred feet or more below the present surface.

The gravel bed is capped by a sheet of tough, impervious clay, varying from two feet to twelve feet or more in thickness. This clay seems to cover the gravel bed like a hood, and the retention of oil in the gravel bed is no doubt due to the peculiar shape of the clay sheet.

Oil formerly issued with the waters of springs, and through the gravel of the creek bottom, in many places along the valley of Oil Creek. The gravel beds have been supplied with oil coming up from the First sand. The First sand lies only 50 feet below the bottom of the drift deposit. For ages the oil has been slowly escaping into the drift and working its way to the surface. In this almost hermetically sealed reservoir the oil has collected and has here remained until set free by the piercing of the clay hood above it.

A little over one acre will cover all the production territory, and on this small area about 100 pits were sunk - 70 on the flat below the road, and 30 above it.

The largest well in the pool yielded 30 barrels of oil the first day. The pool was exhausted by the winter of 1879 after producing ten to twelve thousand barrels.

The shallowest pit was 15 feet deep, with only 2 feet of clay while the deepest 52 feet with 15 feet of clay. The name "Grasshopper City" came from the singular manner in which the hand-pumps were coupled together and worked, at first by horse-power and afterwards by steam.

1 E 4.1 Refinery Site:

This site was formerly occupied by the Oil Creek Refinery now abandoned.

POI	Mileage	
1 F	4.2	Church Run Pool: Cross DAV and P.R.R. a branch of the New York Central R.R. On the east side of the road are a few wells producing at a depth of about 450' from the Venango Third sand in the Church Run pool. Production from this sand extends in a long somewhat narrow streak due north for about 13 miles. The total length of the sand body is nearly 20 miles. The sand is very thin, fine, and shaly, and rarely productive along its western edge which passes through the center of Titusville on a north-south line. Eastward the sand thickens rapidly, attaining 50 feet and more within one-third mile from the edge. It is mostly pebbly throughout its entire thickness, some beds being loose unconsolidated conglomerate with pebbles up to one inch. In places, however, it contains beds of sandstone without pebbles, and a few beds of shale. The permeability is very high, amounting to 2,000-5,000 millidarcies in the loose conglomerates. This pool was discovered by the Eureka well 1 1/2 miles northeast of Titusville in November, 1865. Its maximum production was 175 bbls. per day. Surface water entered the sand through improperly cased wells and flooded the western part of the pool. The pool was abandoned for many years. About 1922 attempts were made to pump off the water. The water was quite fresh and filled the holes to the surface. Many months of pumping were required before appreciable quantities of oil were obtained. Since then the field has been entirely unwatered and has produced largely. The majority of the leases are now being operated under air and gas drive. The small pond north of the railroad was formerly used for the production of ice during the winter months. The ice blocks were cut and stored in wooden buildings.
1 G	4.5	We have crossed Pine Creek and are continuing toward Pleasantville on the old plank road Route 27. The red brick building south of the road and east of the creek at one time was the electric plant for the electric car line between Pleasantville and Titusville.
1 H	4.7	Crossing from Crawford County into Venango County. Notice the terraced sand and gravel banks on both sides of the road. As we start up the hill we are traveling across about 150 feet of the Cuyahoga sandstones and shales comprising the Meadville, Sharpsville and Orangeville formations.
1 I	5.2	Fieldmore Springs Rest Home: A Dr. Birchfield was drilling for oil when the well started to flow fresh water which had a high mineral content. He built a large four story brick hotel and bath houses on this site. Birchfield bottled this water and drove around the country in his horse drawn cart peddling the water. The hotel was destroyed a few years ago by fire. As we ascend the hill notice the spring at 5.4 miles on the left-hand side of the road about two-thirds of the way up. This spring is coming

POI	Mileage	
		from a Shenango sandstone.
1 J	6.2	Sylvania Plant: This was formerly the Tidewater Pump Station. Oil was pumped through this line from the Illinois oil fields to Bayonne, New Jersey. This line was called Benson's Folly. When production decreased in the Illinois fields, sections of the line were sold. The United Natural Gas Co. of Oil City, Pa., bought part of this line. The section from Bradford, Pa., to Bayonne, New Jersey, is still in use. B. D. Benson and McKelvey surveyed a line from Parker, Pa., to Baltimore, Maryland, to put in a 4-inch line. The farmers whose lands they were going to cross had an injunction against them. This and the fact that the Bradford oil field had just been discovered made them give up the plan. They went to Bradford and put in a 5-inch oil line of 109 miles from Rixford, Pa., to Williamsport, Pa. This line was completed November 20, 1867, and was the first line to be laid over the Allegheny Mountains. This venture started the Tidewater Oil Co. On right of road is the grade of the old Pleasantville to Titusville electric car line. Here we cross the Mississippian-Pennsylvanian contact. The Pottsville rocks (Pennsylvanian age) lie unconformably on the older beds which were very gently tilted to the south. The Pottsville group rests on older and older beds towards the north and east. A heavy sandstone of the Pottsville group, occasionally pebbly, caps a few of the higher hills. Good exposures of it are rare, and it is usually seen as large, loose blocks and rock cities. The exact position of its base is, therefore, impossible to determine, but it appears to be from 250 to 300 feet above the base of the Corry sandstone. This sandstone is probably equivalent to the Connoquenessing sandstone which is well developed to the southwest.
1 K	6.6	Between POI-1 H and our present position was a dry streak in the Venango Oil Sand group. We are on the edge of a production belt that extends to the east for about 5 miles and north and south for many miles with only minor interruptions. Production in this belt is from the Venango First, Second, Third Stray, and Third sands and the Lytle sand. On some leases two or three sands are productive. At our present point of interest the Venango First and Second sands are being produced.
1 L	7.5	Pleasantville: So named due to the ideal home conditions existing here. It was founded in 1821.
1 L	8.1	Center of town: Turn left and continue to follow Route 27. The Pleasantville or Black Oil pool was discovered on February 1, 1868 by the Harmonial

POI Mileage

well which is located in the borough about 1,000 feet southeast of this intersection. The wells best production was 125 barrels per day. Production was from the Third Stray sand. The sand is generally pebbly, especially at the top and bottom. It is remarkably uniform in thickness, ranging between 10 and 20 feet. The A. P. I. gravity of the oil ranges from 44° to 50°. The black-oil wells in this district produce no water with the oil. If water reaches the sand face from casing leaks the well is quickly and seriously damaged. The section of the pool within the town limits has been watered out. Pleasantville was an oil boom town. The large brick block buildings were built with oil money. The Eagle Hotel (torn down in 1957) was a large brick building with 50 rooms. John F. Carll, who was head of the oil and gas work for the Pa. Geological Survey from 1874 to 1888, had his office on the third floor of the large brick building directly across the street from the gasoline station. A number of buildings including the Chase House, a large hotel, were moved to Pleasantville from Pithole. The railroad grade from Pithole to Pleasantville was completed, a distance of six miles, but the rails were never laid. A fire on December 23, 1871, burned out most of the Pleasantville business section. The Chase House, a three story frame building with a 150 foot front, was destroyed in the fire. The large red brick buildings replaced part of the burned out business section.

Harmonial Well, Pleasantville: One day, late in the fall of 1867, Abram James, an arden spiritualist, was driving from Pithole to Titusville with three friends. A mile south of Pleasantville the "spirit guide" caused him to jump out of the conveyance and leap over the fence into a field on the William Porter farm. Hurrying to the north end of the field, James fell to the ground, marked the spot with his finger, thrust a penny into the dirt and fell back pale and rigid. Restored to consciousness, James told his friends of a revelation that streams of oil lay beneath the soil. He leased the property, borrowed money, raised a derrick over the spot where the penny lay, and commenced drilling amid the scoffs of unbelievers. When down 700 feet and past the third sand rock, he became the laughing stock of the region; but "Crazy James" kept on drilling. When he proceeded to build tanks to receive the expected oil, people laughed louder. Early in February, 1868, James struck oil and his well, called the Harmonial in honor of the spiritual philosophy, pumped 125 barrels a day. The usual hurly-burly followed. Operators at once rushed into secure leases on adjoining farms, and the fact that experienced oil men were willing to pay $500 to $1250 and acre created confidence in the territory. New strikes increased the excitement.

The surface rocks of Pleasantville are Pottsville. The highest point in Venango County is the Pleasantville Cemetery where the elevation is a little over 1720 feet above sea level. The Pleasantville water supply

POI	Mileage	
		comes from drilled wells penetrating the Connoquenessing sandstone and sandstones in the Shenango. As we descend the road to Enterprise we pass over the Pennsylvanian-Mississippian contact and the road continues in Mississippian rocks until we travel halfway down the hill into Tidioute; except for some Pottsville sandstone at Triumph.
1 M	8.8	The edge of the third sand parallels this road. The producing part of the field was to the left of the road. The Nettleton No. 1 well produced 35 barrels per day. The sand here was only 10 feet thick.
	10.8	Crossing Pine Creek. Junction of Route 27 with road from East Titusville.
1 N	10.9	Outcrop of Corry: Leave Route 27 and bear right on blacktop road toward Tidioute. Just to left of this intersection on Route 27 is a spring coming from a good exposure of Corry sandstone.
1 O	13.5	Colorado Oil Pool: Crossing a branch of Pine Creek (good fishing). This area is known as Colorado. Production here is from the Second sand and Third Stray. These leases are under air and gas drive. This Colorado pool is the southwestern end of the Triumph Streak. Following this streak to the northeast, it attains a thickness of more than 100 feet near Tidioute. The Colorado pool was discovered in 1870 and was very productive. The Goodwill Hill-Grand Valley pool, to the north, producing from the Third Stray sand covers about 7,400 acres. The sand at its maximum is 60 feet thick. Initial productions in this area were several hundred barrels per day. Intensive air drive is now being very successfully applied to this pool.
1 P	14.7	Air Drive Project: Quaker State Oil Co's. air drive project. Plant is on left side of road.
1 Q	17.1	Triumph Streak Oil Pool: The Triumph Streak oil sand is the Venango Third Stray sand. It lies about 490 feet below the Corry sandstone. In the Triumph Streak the shale between this sand and the Venango Third sand below is absent and the combined sands are designated Third sand. In the eastern part of the Triumph Streak oil pool the sand thickens toward the center of the Streak. Except for regional tilting and downward scouring, the bottom of the sand here is essentially horizontal. Accordingly this "anticline" should not be expected to carry to deeper sands. It does extend upward, with diminishing intensity, through the Second sand and the Corry because of the compaction of the shales around this thick sand lens.
		The Triumph Streak is about 8 miles long and 600 to 1800 feet wide and extends from south of Tidioute westward to Pine Creek. Discovered in 1860, the year after the famous Drake well at Titusville, it has had two periods of development. The first period extended from

POI Mileage

1860 to 1874. During the early stage of this first period the practice was to drill only into the upper part of the sand. The initial production of these wells ranged from 10 to 500 barrels per day. Some of the wells yielded only gas. A 500-barrel well was drilled on the island at Tidioute, Other wells were drilled on rafts in the river and had to be reclaimed after each flood. Later in this first period, as casing came into use and the total thickness of the sand was drilled, wells with reported initial productions up to 1,000 barrels per day were obtained. During the latter part of this first period water entering the sand through leaky casing and unplugged abandoned wells was flooding the field and by 1874 it was being abandoned. Gradually the water spread until practically the entire pool was flooded and abandoned. The second period of development started in 1898 and was characterized by dewatering of the flooded land. Persistent pumping of the flood water reclaimed most of the old abandoned acreage. When dewatered, the average wells produced 10 to 18 barrels per day. The average present production of Triumph Streak wells is said to be .13 barrel per day.

The sand of Triumph Streak is a conglomerate consisting predominately of white quartz pebbles 2 to 3 millimeters in diameter in which occur discoidal pebbles 1 to 2 centimeters in diameter. These larger pebbles occur most abundantly in the eastern part of the pool where the sand is thickest.

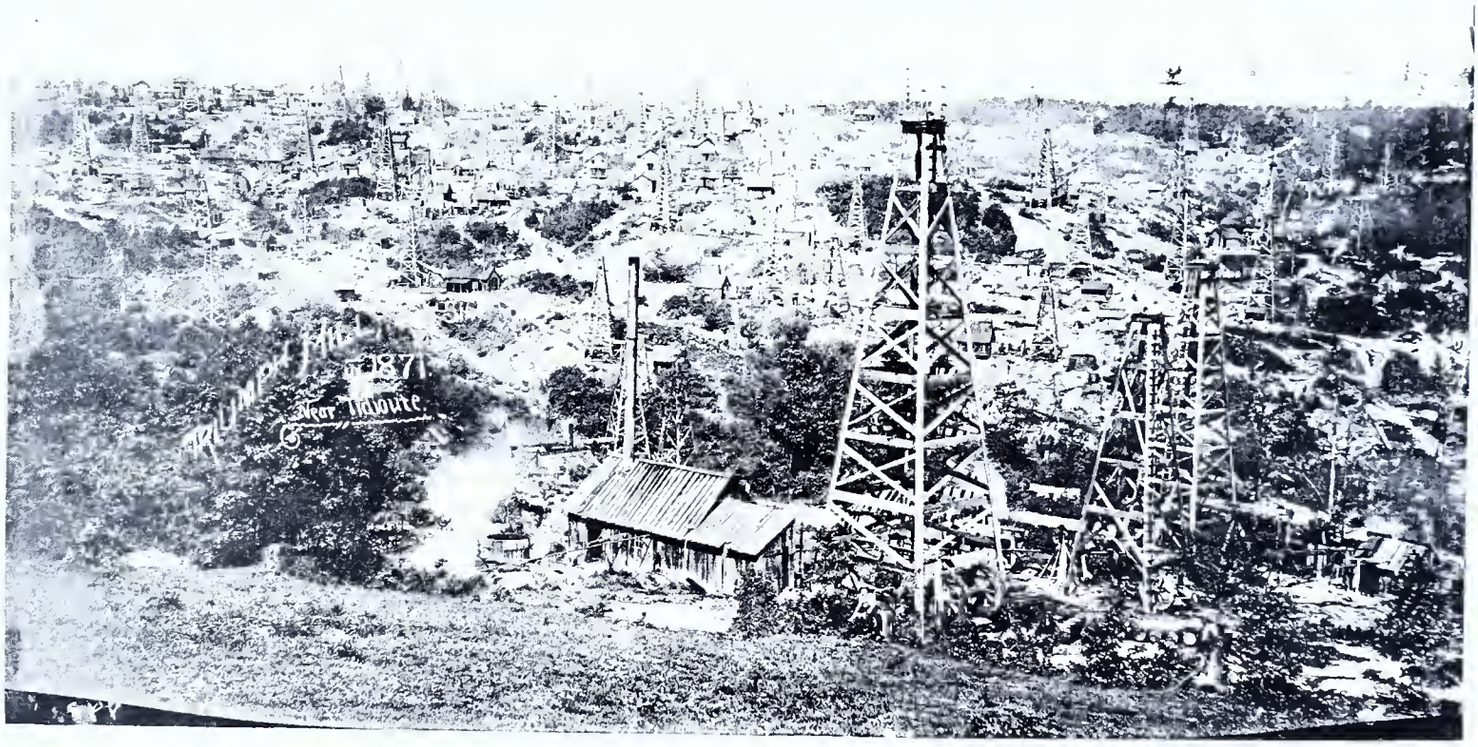
The sand ranges from about 20 to 120 feet thick. In the western two miles of the pool in this quadrangle the sand is 40 to 60 feet thick. It thickens eastward to a maximum of 120 feet about half a mile west of the river. This eastward thickening is by addition at both the top and bottom of the sand, but most of it occurs in the bottom, apparently filling a scour channel. East of the river the sand thins rapidly to about 40 feet south of Tidioute. The sand is thicker through the center of the Streak than near the edges. From a maximum central thickness it thins very abruptly and apparently divides into two sand members separated by shale. The oil is black or very dark green and the sand is called the Black oil sand in some areas. It carries saltwater.

A suburb of this town of Triumph was Babylon. Ben Hogan who titled himself "the wickedest man in the world" operated here.

1 R 19.5 Junction of 127. Turn left down Tidioute hill. The rocks outcropping at this point of interest are of Mississippian age. As we descent the hill, at mileage 20.0 the Corry outcrops. Exposures are hard to find. At mileage 20.4 the First Venango oil sand outcrops. At Stop 2F we will closely examine this sand.

Stop II. 20.7 Oil Spring: (Buses will park in parking lot on right side of road near building).

Tidioute is an Indian name signifying a cluster of islands. This oil spring at the edge of Tidioute was known long before the drilling of the Drake well. News of the Drake well reached Tidioute in two days.



TRIUMPH HILL
1871

POI Mileage

Young J. L. Grandin heard the story and immediately purchased the 30 acres of the Campbell farm on which the oil spring was located for $300. He drilled a well at the location of this spring to a depth of 134 feet. After some hard drilling the bit stuck and the well was called a dry hole October, 1859. The oil in the spring is evidently coming from the Venango Third Stray sand about 150 feet below this spring. The oil is probably migrating up a fracture to the valley gravel or to the Lytle sand which outcrops in the hillside beside the spring. If the above well had been drilled a few feet deeper it would probably have been a producer. This well is on the Triumph Streak. Production from this spring amounts to about 1/2 bbl. of oil per day.

The Lytle sand is an irregular sandstone horizon, the top of which ordinarily lies about 340 feet below the Corry sandstone and about 150 feet above the Third Stray sand. The Lytle sand outcrops along the Allegheny River as far south as about half a mile north of Trunkeyville, where the general south regional dip carries it below river level.

Typically the Lytle sand is a medium- to fine-grained, gray sandstone. On the outcrop it varies irregularly from massive, non-shaly sandstone to thinly-bedded argillaceous sandstone with included layers of shale. Similar subsurface variations are indicated by the well records. Small pebbles are common in it both on the outcrop and in well samples. Although these pebbles are not confined to any particular part of the sand, and in places are irregularly scattered throughout its entire thickness, a thin pebble streak in the top of the sand is usually characteristic of it. The thickness of this sand ranges up to 30 feet.

20.9 Tidioute: The first oil well casing was used on the island here by Julius Hall December 1861. The first pump was used here by Mead and Bailett well December 1860. The first oil pipeline to cross a river was laid here.

21.1 Stop sign: Turn right and cross the railroad tracks and Allegheny River.

21.4 Stop sign: Turn right onto Route 62.

2 A 21.5 First Flowing Well: the first flowing oil well was drilled to the right of Route 6. Production was from the Third Stray sand Triumph Streak.

2 B 21.7 Economites and Tidioute Oil Shaft: The Economites of Economy, Beaver County foreclosed a mortgage and bid in a tract on the steep southside along the Allegheny River at Tidioute. Their first five wells yielded an aggregate of about 60 barrels daily of heavy oil, the depth of none of the wells being over 120 feet.

A large boarding house was erected for the workmen, whose speech and manners were regulated by printed rules. During 1868 the society

POI Mileage

sold about 100,000 barrels of oil. Seventy-six wells were drilled between 1860 and 1873; the largest one produced 250 barrels a day. The Economites never pumped their wells on Sunday.

Just south of the Economites tract the Enterprise Mining and Boring Company of New York leased 15 rods square on the Tipton farm to sink a shaft seven feet by twelve feet. Bed-rock reached at thirty feet, followed by ten feet of shale, ten feet of gray sand, forty of shale and siltstone and twenty of sand. The shaft, cribbed with six inch plank to the bottom of this sand, tightly caulked to keep out water, was abandoned at 165 feet. One of the workers threw a match down the shaft which caused an explosion toppling the superintendent into the shaft. The superintendent was killed and the timbers wrecked. This stopped the operations. The shaft was dug in the front yard of the small house on the east side of the road.

2 C 22.4 Red House Oil Pool: Sand and gravel river deposits on the east side of Route 62.

This point of interest is in the Queen sand pool called the Red House Oil pool. The Queen sand is a white, coarse to pebbly sandstone about 1260 feet below the top of the Corry sandstone and 770 feet below the Third sand. It is 1 to 15 feet thick, In some well records it is reported to be as much as 75 feet thick, but associated shale and shaly sandstone doubtless are included as sand. The Queen sand occurs as a series of lenses at the bottom or in the lower portion of a dark shale or shaly sandstone. This shale and shaly sandstone, called Queen sand "formation" in well records, are 100 to 120 feet thick. Although quite irregular, this "formation" with its lenses of white sand forms a distinct stratigraphic unit which is persistent and readily recognized in the area. It occupies the stratigraphic position of the Glade sand at Warren. The Queen sand is the main gas-producing sand in the area, and ranks about fourth as an oil producer.

This Red House pool was prolific but short-lived. The discovery well, completed in April, 1922, had an initial flow of 120 bbls. per day and a rock pressure of 700 pounds per square inch. The "pay" in the pool is 4 to 15 feet thick and the initial production of the early wells varies directly as the sand thickness. The pool reached a peak production of about 1,500 barrels natural flow per day about six months after its discovery.

We have been traveling along the Lytle sand outcrop. As we continue south on Route 62 we will be clinbing up in the section as the beds dip to the south. Soon we will be traveling along the outcrop of the Venango First sand.

25.6 Warren-Forest County Line.

POI	Mileage	
2 D	28.3	Pennsylvania Historical Marker: Lawunakhannek- name of Indian mission near here at which the first Protestant church building west of the Allegheny mountains was built by Zeisberger in 1769. Term is Delaware word meaning "northerly stream place".
2 E	29.5	Junction of Route 62 and 127. Pennsylvania Historical Marker: Goschgoschink - name applied at the time of Zeisberger's arrival in 1767 to all three of the refugee Indian towns. Later names were given to "Upper Town" located across the river at this point, now West Hickory.

Stop III. Outcrop of First Venango sand. Buses pull to extreme right of road to park.

The First sand here occurs as local lenses or layers of fine- to medium-grained white or gray sandstone in an irregular group of thin-bedded shaly sandstones and sandy shales. These shaly sandstones and sandy shales are designated First sand "Formation" in the well records. The top of these sand lenses, as recognized in the well records, is usually about 260 feet below the top of the Corry sandstone and about 230 feet above the top of the Third sand, but neither the top nor the bottom of it is clearly defined throughout the area. The First sand "formation" ranges from 35 to 75 feet thick, often within short distances. Variation in sand content rather than in the actual thickness of the "formation" probably accounts for most of this irregularity. The First sand lenses are 1 to 45 feet thick, usually occupy about the central portion of the "formation" but are somewhat variable in stratigraphic position.

The First sand "formation" outcrops in the valley of the Allegheny River from Tidioute to about a mile south of West Hickory, where the regional dip carries it below river level. The top is 1230 feet above sea level, or about 130 feet above river level in the Dennis Run section at Tidioute. The "formation" is here about 30 feet thick. At most of the outcrops it is a very fine-grained thin-bedded sandstone. Plant fossils occur sparingly in it. The only known exposure of clean sand that probably would yield oil or gas is under cover in an outcrop of medium- to fine-grained sandstone in a bluff on the west side of the river one mile south of Tidioute. Well samples indicate that the productive First sand is of the character noted at this outcrop.

The First sand ranks first in oil production in the Tidioute area. Although primarily an oil sand, it produces relatively large amounts of gas in several localities. Overlying the First sand is the Riceville shale, which contains occasional thin silty sandstone beds, is 90 to 100 feet thick extending from 100 to 200 feet below the Corry sandstone. These shales are characteristically reddish and are generally noticed but not recorded by the drillers. The Riceville shale of this outcrop is high

POI	Mileage	
		in the cliff where we can't examine it. In the ditch along the face of this outcrop you can find a piece of reddish shale or siltstone. Take a piece of this with you to Stop IV. where we will examine the Riceville shale and compare it with your find at this stop.
3 A	32.0	Forest County Home: In the fields between Route 62 and the Allegheny River two folsom points have been found. Only one other folsom point has been reported found in Pennsylvania. These date back 10,000 years to the end of the glacial period.
3 B	34.9	Tionesta: Indian name "Home of the Wolves". This is the County seat of Forest County. Tionesta fish hatchery is located on the east side of Route 62. Historical Marker Damascus - later name of Zeisberger's "Lower Town" located opposite side of river here. Residence of a Seneca sentinel chief at the time. Town name was taken from the Munsee word "muskrat".
		Tionesta Dam is located about one mile south of Tionesta on Tionesta Creek. This dam is part of the Flood control for the Ohio Valley.
	35.9	Junction of Route 62 and 36. Turn right and cross Allegheny River on Route 62.
	36.2	Turn left on Route 62.
Stop IV.	36.4	Buses park on wide berm of road on right. After passengers alight, turn buses around heading in opposite direction.
		Mississippian-Devonian contact and Corry outcrop: At this road cut we can see the top of the Riceville shale about 4 feet above the road. The Cussewago shales and siltstones are exposed above it. The Riceville shale is characterized particularly by its purplish-red color, and is generally known to the drillers as the "red rock", although it is seldom reported in well records. The formation is composed of dark brownish- or purplish-red shale and micaceous sandy shale, some greenish gray shale and sandy shale, some dark gray shale, and a little fine white sandstone in thin beds. Examination of the outcrops, drill cuttings, and electric logs indicate that this formation is a stratigraphic unit, distinguishable from the sandy Cussewago above and the First sand formation below. It corresponds exactly in thickness and position with the Riceville shale as defined by I. C. White, although it is not included in his Riceville section.
		Caster's suggestion that this member be called the Oswayo shale seems unfortunate. The Oswayo of the Bradford district is distinguished from the underlying Cattaraugus principally on the basis of its greenish and gray color, and both Oswayo and Cattaraugus are names of facies.

POI Mileage

The Riceville shale is very probably the equivalent of the upper part of the Oswayo of the type region, but much more detailed work must be done before the Oswayo-Cattaraugus contact can be identified in this area. Bright red strata are often associated with the Second sand formation in the Venango field, and these rocks are undoubtedly equivalent to some part of the Cattaraugus.

There is no evidence in the area for a disconformity at the top of the Riceville shale, but Caster's suggestion that it marks the top of the Devonian system seems reasonable.

We will walk back past the buses up the hill to the Corry outcrop.

The Corry sandstone is the most persistent of the sandstones of the area, and is the only one suitable for use as a key horizon. It is a fine, rather massive, but occasionally platy sandstone, pure white, yellowish white, or light gray on a fresh surface, and characteristically weathers pasty or chalky white to yellowish. It is harder and more compact than the other sandstones. In some parts of the area it can be divided into an upper sandstone, a middle shale, and a lower sandstone. The Corry is about 20 feet thick.

The lower member is very calcareous in the bottom 1 to 2 feet. These lower beds are sometimes richly fossiliferous.

Return to the buses and we will retrace our route to 2 E.

2 E 43.1 Turn left and cross Allegheny River. Narrow bridge - one car width over the river. Wait your turn. Enter town of West Hickory.

43.4 Turn right and follow Route 127.

4 A 45.1 Since leaving West Hickory we have passed over the Mississippian-Devonian contact and the Mississippian-Pennsylvanian contact and find at this point of interest rocks of Pennsylvanian age, the Pottsville Group. We will be in this group as far as Fagundus. The Pottsville here is conglomeratic.

47.8 Turn left and follow 227.

4 B 48.1 Fagundus: On May 1, 1870 William H. Calvert and Co., drilled in the "Venture Well" on the Tuttle farm at Fagundus for the discovery well. The well was sold for $15,000 when it touched the Third sand. The well was 800 feet deep and flowed 300 bbls. a day. The day after it began flowing, the Fagundus farm of 160 acres was sold for $120,000. Some wells produced as much as 1,000bbls. per day. The town grew to a population of 2,500 with a daily production of 3,000 bbls. The thriving city built board walks, a bank, a newspaper office called "The Press", a post office and a telegraph office. Stage coaches left hourly

POI Mileage

to surrounding towns. Water sold at $1.00 per barrel. The white pebbles from the Pottsville conglomerate at Fagundus were called "oil beads" by the old timers. A book written about this city was called "Battle City" because of the numerous fights that were had over oil properties.

The Fagundus pool lies about three miles south of Triumph Streak. It is roughly circular, covers about 1,200 acres, and has produced oil continuously since its discovery in 1870.

The Third Stray sand, which is the producing horizon, is 30 to 40 feet thick in the central part of the pool and thins outward from the center. It is predominantly a medium-coarse gray sandstone, but includes pebble layers, especially at the top and bottom. Shale and hard non-productive sand occur irregularly in it.

This pool lies on the gentle southwest-plunging Fagundus anticline, which may have an important influence in the accumulation of the oil. The producing area is controlled directly by sand conditions, however. The sand becomes thin, hard and non-productive at the outer edge of the pool. Repressuring with gas and air is practised successfully. The oil is very dark green.

49.5 Valvoline Pipeline Pump Station: Between here and point of interest 4D we will be traveling over Pocono rocks in the low places and Pottsville rocks on the hill tops.

52.5 Neilltown: Turn left leaving Route 227. Between here and Stop V. we will be passing near or through spotty oil production from various Venango sands.

56.2 White Church: Bear right at Y in road.

57.7 Washington School: Turn right for one tenth of a mile to Route 36. Turn right onto Route 36.

4 C 58.0 Route 36 is the Colonel Drake Highway.

58.3 Forest and Venango County line.

4 D 60.1 Temperance House: Turn left. Site of an early church. From here to Pithole we will be passing over Mississippian rocks. The Pottsville sandstone caps the hills.

60.9 Turn left. Stay on this black top road to Stop V.

61.1 Crossing Pithole Creek.

4 E 62.4 Tight pinch: Cross the stone arch bridge over Pithole Creek and turn

POI Mileage

left. We are now again on the old plank road from Titusville to Pithole. A couple of miles toward Pleasantville on this road is a place called "Tightpinch". The name came from the narrowness of the road which passed between two large Pottsville boulders. Many a barrel of oil was spilled here by the teamsters hurrying to Titusville with their load of oil only to have a wreck at Tightpinch. An early cemetery is located about 1,000 feet down Pithole Creek on the west side of the creek. The cemetery is entirely overgrown.

4 F 63.2 Morey House: Site of the Morey House, a hotel at the edge of Pithole City. This hotel was destoryed by fire.

4 G 63.6 Van Syckel Pipeline: The world's first successful oil pipeline crossed the road at this point. Samuel Van Syckel, in August, 1865, completed a two-inch line from Pithole to Miller Farm, the railway terminus, 5 1/2 miles away. Four pump stations helped force some 800 barrels of crude oil daily to the shipping point, thus revolutionizing the transportation of petroleum. The Van Syckel line was dug up when Pithole wells were pumped dry. The trench is visible here and can be followed all the way to Miller farm.

Stop V. 63.8 The Vanished Oil Boom City of Pithole (lunch stop): Buses will park at souvenir stand. Read the story of Pithole in the front of this log book. The present owner of Pithole, Mr. James B. Stevenson, will guide us on a tour of Pithole. Mr. Stevenson has put in a lot of time and money in marking sites and clearing the ground so Pithole as it was can be visualized by people visiting it today.

After our tour of Pithole, we will eat our lunches and have some time to walk around and see points of interest. Use the map of Pithole in this log book as your guide.

64.3 Pithole School: Turn left and follow black top road to Route 227. Notice the grade of the old Pithole Railroad on the left side of the road.

5 A 66.2 Stop sign: Turn left onto Route 227 toward Oil City.

The Van Syckel pipeline crosses Route 227 about two miles north of this point. A piece of the old pipeline was found in the trench a couple of years ago. On the left hand side of Route 227 where the pipeline crosses the road and within 50 feet of the trench are two large pits which were dug by hand many years ago. A tree over a foot in diameter is growing in the center of one of the pits. The pits are about 20 feet across, 12 feet deep, and the sides are very steep. It is still a mystery as to why the pits were dug.

We have climbed up on the Pottsville again, but will leave it on our descent to Plumer and will be in the Pocono to point of interest 6B.

POI	Mileage	
5 B	67.4	Rouseville Water Supply: A large flow of water comes from a coarse-grained sandstone in the Cuyahoga group and is piped to Rouseville.
	67.6	Town of Plumer
5 C	68.8	Humbolt Refinery: This was one of the largest refineries in the world in 1862. The area inclosed was nearly 25 acres and the works so planned as to take advantage of the natural descent of the ground, in the passage of oil from one set of vessels to another, thus dispensing with the use of artifical power. This refinery had 20 cheesebox stills. A two-inch cast iron pipeline was laid from the Tarr farm wells along Oil Creek over the hill to the Humbolt refinery in 1862. About 1,000 barrels of oil were pumped through this line. The joints were packed with oakum and lead. The line leaked too much so the project was abandoned. This was the first time that oil was pumped over a hill. The oil from this refinery was for the most part exported to Europe. Oil barrels were manufactured at the refinery. The capacity of the refinery was 500 barrels daily. In 1866 the refinery had a disastrous fire and was abandoned shortly thereafter. Today all that is left are the outlines of the buildings, and large piles of bricks.
5 D	70.7	Reed Well: In 1861 Thomas Duff purchased five acres of rocks and stumps from John Rynd. Duff sold two acres to Robert Criswell. William Reed in 1863 drilled a well 600 feet deep which was dry. In May 1864 Taylor and Rockwell drilled a shallow well nearby to a depth of 200 feet which produced 75 barrels daily. Criswell with Reed and I. N. Frazer located a well on Criswell's two acres just 66 feet from the dry hole. On July 18, 1864, this well called the Reed Well started flowing 300 barrels daily. The combined interests of the three sold for $685,000 to Mingo Oil Co. The five acres with 11 wells and one dry hole brought in two million dollars. I. N. Frazer loomed up shortly thereafter as the founder of Pithole. Today many wells are producing from the Venango Third sand in this area.
	71.0	Rouseville: Named for H. R. Rouse who died in the disastrous oil-well fire of the Rouse well in 1861. The town was founded in 1798.
	71.8	Traffic Light: Turn left onto Route 8.
5 E	72.0	The cast iron drive pipe, about 3 feet high on the left side of the road next to curb, was used in the very early wells. The pipe is about one inch thick. One joint was set on top of the lower joint as the joints were driven down the hole. Occasionally the joints would be strapped together. Corry outcrops on left bank.
5 F	72.1	Rouse well: Located on right side of road. The first well to tap the rich Third sand pool near Rouseville was located on the John Buchanan farm. The lessees, Little and Merrick, started drilling in the spring

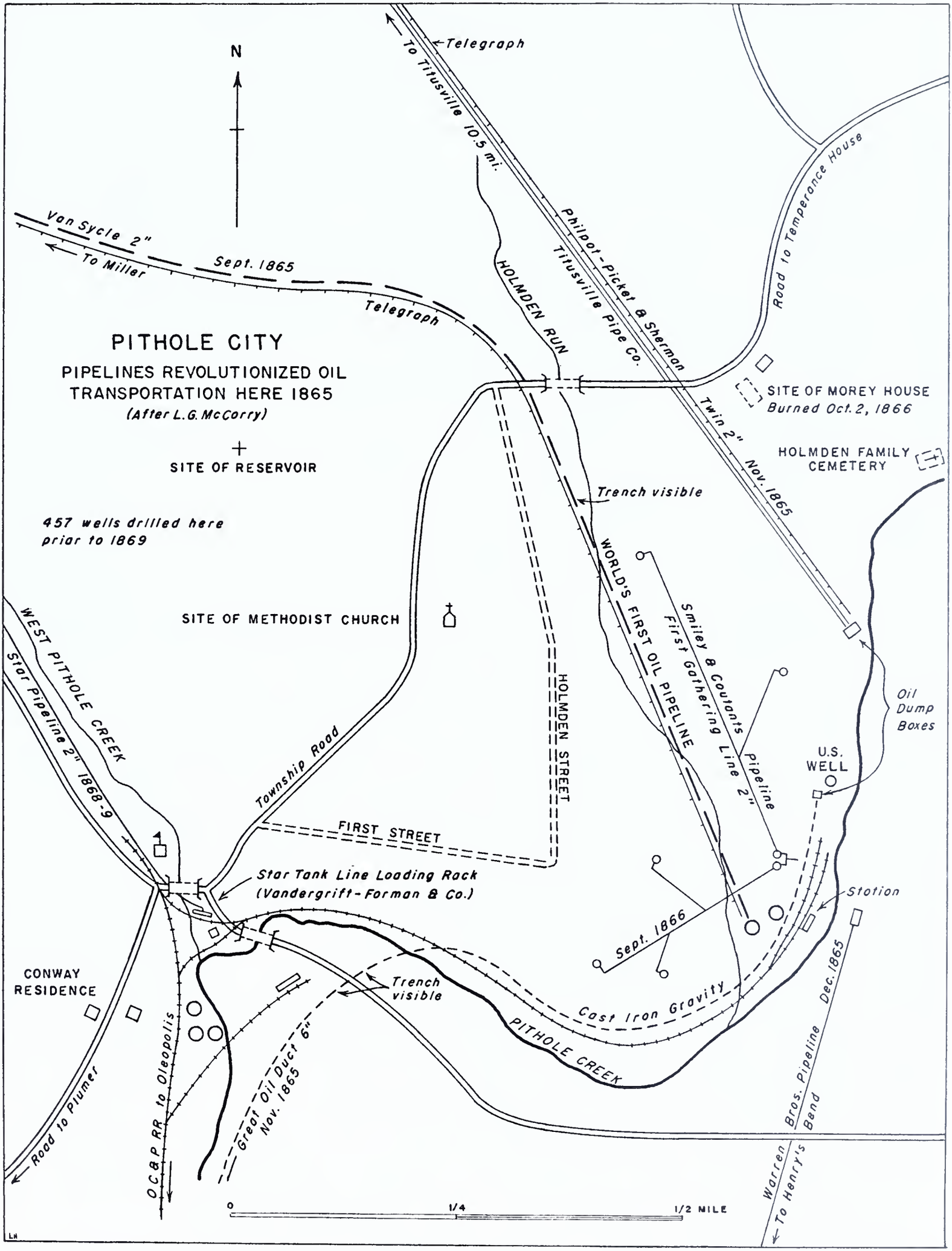
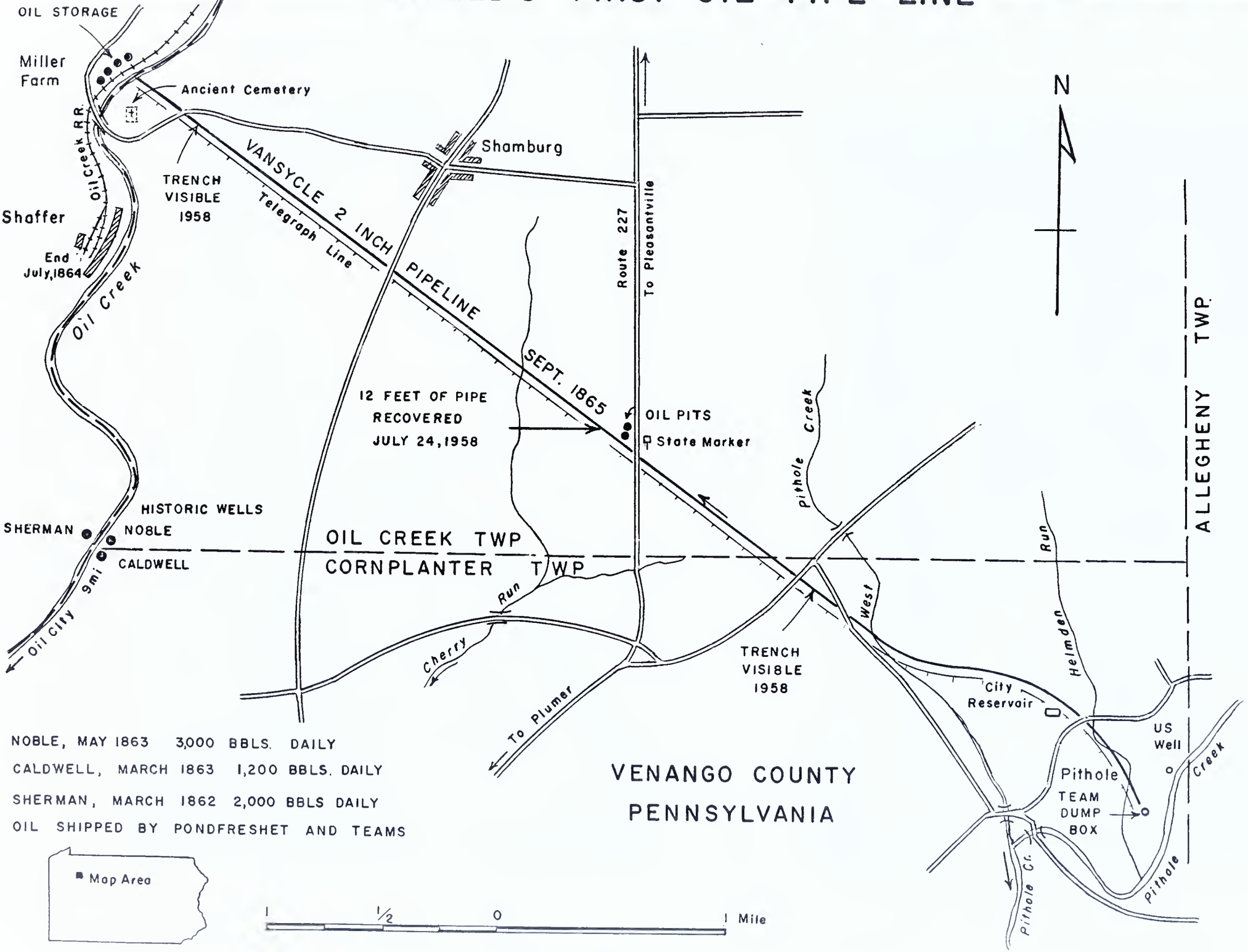

N
Telegraph
To Titusville 10.5 mi.
Philpot-Picket & Sherman
Titusville Pipe Co.
Road to Temperance House
Van Sycle 2"
To Miller
Sept. 1865
Telegraph
HOLMDEN RUN
PITHOLE CITY
PIPELINES REVOLUTIONIZED OIL TRANSPORTATION HERE 1865
(After L.G. McCorry)
SITE OF RESERVOIR
457 wells drilled here prior to 1869
SITE OF MOREY HOUSE
Burned Oct. 2, 1866
Twin 2" Nov. 1865
HOLMDEN FAMILY CEMETERY
Trench visible
WORLD'S FIRST OIL PIPELINE
Smiley & Coutants First Gathering Line 2"
pipeline
Oil Dump Boxes
U.S. WELL
SITE OF METHODIST CHURCH
WEST PITHOLE CREEK
Star Pipeline 2" 1868-9
Township Road
HOLMDEN STREET
FIRST STREET
Star Tank Line Loading Rack
(Vandergrift-Forman & Co.)
Station
Sept. 1866
CONWAY RESIDENCE
Trench visible
Cost Iron Gravity
PITHOLE CREEK
Bros. Pipeline Dec. 1865
Bend
Road to Plumer
O C & P RR to Oleopolis
Great Oil Duct 6" Nov. 1865
Warren
To Henry's
0
1/4
1/2 MILE
LH

Fig. 6

WORLD'S FIRST OIL PIPE-LINE



After L.G. Mc Corry August, 1958

V.F

Figure 7

PITHOLE CITY
1865

HOLMDEN and FIRST STREETS
Pithole City, 1865

of 1861 on the north side of the farm, east of Oil Creek, and back at the junction of the bottom land and a steep hill. About sunset on April 17, 1861, the driller struck not only a heavy vein of oil but a huge gas pocket, and the well commenced gushing at the astounding rate of 3,000 barrels. A workman rushed to Anthony's Hotel, a short distance away, to tell Henry Rouse, one of the lessees of the farm, George Dimmick, the superintendent, and others, who were discussing the fall of Fort Sumter, about the sensational strike. Everyone at the hotel ran towards the well, except Dimmick, who hurried away to secure barrels. News of the strike rapidly circulated, and within a short time at least 150 people had assembled to see the giant gusher.

Having arranged for the barrels, Dimmick ran towards the well, and when within twenty rods a sheet of fire, as sudden as lightning, burst forth, followed by a terrific explosion that sounded like the report of a heavy piece of artillery. Instantly an acre of ground with two wells, oil vats, a barn, and over 100 barrels of oil, were ablaze. The well continued to spout oil high into the air, which fell to the ground, igniting as soon as it fell and adding dense smoke and sheets of flame to the horrors of the scene. Those standing about the wells were either stunned or prostrated by the explosion; oil saturated their clothing and most of them became human torches and frantically tried to escape from the fiery furnace.

Rouse was standing within twenty feet of the well when the explosion occurred. Retaining his presence of mind, he started running toward the hill. He had not taken more than a half-dozen steps when he stumbled and fell. Burying his face in the mud to keep from inhaling the flames, he recovered, started up the ravine, fell a second time, exhausted, but two spectators rushed to his aid and dragged him out. His entire body from the head, down the back and legs to the knees, was burned to a crisp. Taken to a nearby shanty and placed on a bed, he suffered the most excruciating pain.

Rouse remained conscious for four hours, but showed no sign of his terrible distress. With coolness and precision, he clearly and concisely dictated his will, while someone administered water with a spoon in the middle and at the end of every sentence. After remembering his family and intimate friends, he bequeathed the bulk of his estate to the Commissioners of Warren County, Pennsylvania, the income from which was to be used for roads and to aid the poor. Within less than an hour after completing his will, he died.

Of the eight men talking about Fort Sumter at Anthony's Hotel before the fire, Dimmick was the only one to escape injury, and Rouse the only one to burn to death. Altogether nineteen persons ultimately lost their lives and property damage amounted to about $20,000. If the explosion had come an hour later, it would have claimed more victims, for scores of people were constantly arriving at the well.

The well burned for three days and made a magnificent sight. From a pipe six inches in diameter, a solid column of gas and oil extending sixty or seventy feet in the air, burned brilliantly with immense clouds of dense black smoke rising skyward. Hundreds of people came to see the wonder and visit the scene of the disaster. The fire was finally smothered with manure and earth and brought under control.

Some believe that the explosion was caused by Rouse's smoking a cigar, but contemporary accounts do not substantiate the charge. On the contrary, it appears that he exercised great care in banning lighted pipes and cigars from the immediate vicinity of the well. The generally accepted view is that the explosion and fire resulted from the gas coming into contact with a boiler at a neighboring well about ten rods distant.

5 G 72.4 McClintockville: An early oil town. The first record on a map, date June 23, 1755, of an oil spring in this state is the location of the oil spring just below the bridge. At this spot oil was collected from pits on the banks and from the waters surface on Oil Creek. Nathanial Cary was the first to market oil from this spring to Pittsburgh 1810 to 1815. His cargo was two five gallon kegs slung across his horse. The highest annual production was 10 to 16 barrels. Known for many years as McClintockville, some of the nations oldest wells produce here.

72.5 Immediately after crossing Oil Creek turn right at Pennland and cross railroad tracks on cinder road.

5 H 72.6 McClintock No. 1: Oldest producing oil well in the United States. This well has produced continuously from the Second and Third sands since August 1861. It was drilled only two years after the Drake well.

Characteristically the Third sand is pebbly, and pebbles are more abundant in the upper part of the sand body. The permeability is extremely variable, ranging from several thousand millidarcies in the pebble beds of the thick parts of sand in the northern part of the pool to less than one millidarcy average in the finer and poorer parts of the sand. The permeability, porosity, and oil content, as a rule, decreases as the thickness decreases.

The Third sand of the Rouseville-Oil City pool is characterized by multiple bars or "streaks", as it is in the Titusville area. Belts ranging from 500 feet to 2,000 feet in width, trending north or northeast, are separated by relatively poor and barren belts of approximately the same width. The oil is dark green, with an A. P. I. gravity of 42° to 47°. Since 1930 parts of the pool have been repressured with air.

The Second Venango sand is also productive in this Rouseville-Oil City Pool. It covers a larger area than the Third sand. Most drillin before 1880 was in the hope of finding large Third sand wells, and the

POI	Mileage	
		Second sand was not generally developed until the late 1880's. This sand is 20 to 35 feet thick. The sand is generally medium- to coarse-grained with a conglomeratic bed either at the top of the sand body or in the middle. The porosity is between 15 and 20 percent, the oil saturations 15 to 30 percent, and the permeability ranges up to 600 millidarcies. Initial productions ranged betwen 5 and 50 barrels per day. Some of the early wells had a much higher initial production. At present much of the pool is operating under air drives.
5 I	73.3	A concrete pier has been constructed out into Oil Creek where a well has been drilled from this pier. South of Oil City along the Allegheny River a number of wells were drilled on such piers.
5 J	73.8	Coal Oil Johnny's Home (small house next to barn): John W. Steel, more familiarly known as "Coal Oil Johnny", was the adopted son of Culbertson McClintock and his wife. McClintock died before the oil rush. Mrs. McClintock leased a portion of the farm, excellent paying wells were struck, and she acquired considerable wealth, When she died in 1864, the twenty-year old Steele inherited the farm and cash estimated at $300,000. His daily income from oil was placed at $2,000 a day. Upon attaining his majority Steel decided to see the world and began a spending orgy that extended over the next twelve months. He went to Philadelphia and New York, became a victim of strong drink and bad company, and squandered his fortune. Because he derived his wealth from oil, newspapers nicknamed him "Coal Oil Johnny" and published the most sensational stories about his wild escapades.
	74.3	Stop sign - Route 8: Cross Route 8 and continue on black top road along Oil Creek.
5 K	75.7	Tarr Farm: In October, 1861, the Phillips well on the Tarr farm began flowing 4,000 barrels; it finally settled down to 2,500 barrels and continued at this rate for months. Until 1884, when the Armstrong Well No. 2 in Butler County came in at 10,000 barrels per day, the Phillips well held the initial production record in Pennsylvania. At the end of the first year it was flowing 3660 barrels per day. About four rods away from the Phillips, N. S. Woodford drilled another well which flowed 1,500 barrels in July, 1862. Completely unprepared for the flood of oil which came from the Phillips and Woodford, the owners dug holes in the ground and cribbed them with timber in order to store the oil. In time these tanks covered several acres and can be seen today. An attempt was made to pipe this oil to the Humbolt Refinery at Plumer. When the Phillips well came in the oil market was 10 cents a barrel. By 1865 James Tarr had received one million dollars in royalties and sold the farm for two million. At its height "Tarr Town" had a fine hotel, "The James House", post office and a population of 2,000 people.
5 L	77.2	Hogback: At one time Oil Creek flowed around this hogback. The Corry sandstone can be seen cropping out on the eastern end of the ridge.

POI	Mileage	
	77.4	Petroleum Centre: Cross Oil Creek and continue up hill.
5 M also Stop VI.	77.8	Great Petroleum Shaft: The buses will let out the passengers and proceed to turn around.

The shaft, 12 by 17 feet, was planned to go straight down into the earth 500 feet "for investigating purposes". The backers of the project wanted to see with their own eyes the nature of the strata underneath that was pouring out oil and gas with such profusion almost every time a well was drilled. They hoped "to prove that oil exists in regular veins; the extent and direction of same". The shaft was sunk 30 feet in the first two weeks of work in July 1865, by the 14 hands employed. The director of the work had had mining experience in Schuylkill County. He counted on using a windlass to remove debris for the first 100 feet unless water interfered. After that depth was reached, machinery for hoisting, pumping and ventilating would be installed, the pump engine of 90 h.p. and the hoisting and ventilating engines of 50 h.p. each. The work went on night and day.

The site chosen was 20 rods from the Jersey well, a 300 barrel well that came in in 1864 and the same distance from the Maple Shade well, a 900 barrel producer in 1861. It was 40 rods from the Coquette well, which flowed 800 barrels a day. Twelve months was the estimated time for completion of the shaft.

In September, 1865, the shaft was 73 feet deep, according to D. W. Davies, engineer and superintendent. Work was suspended pending the arrival of the machinery mentioned above. The cost of transporting the machinery was figured at $ 1,500 from Schuylkill County.

What happened next is not clear to historians of today. However, the experiment was never completed and the masonry being built here can be seen today in the woods a few feet to the right of the Petroleum Center-Plumer road.

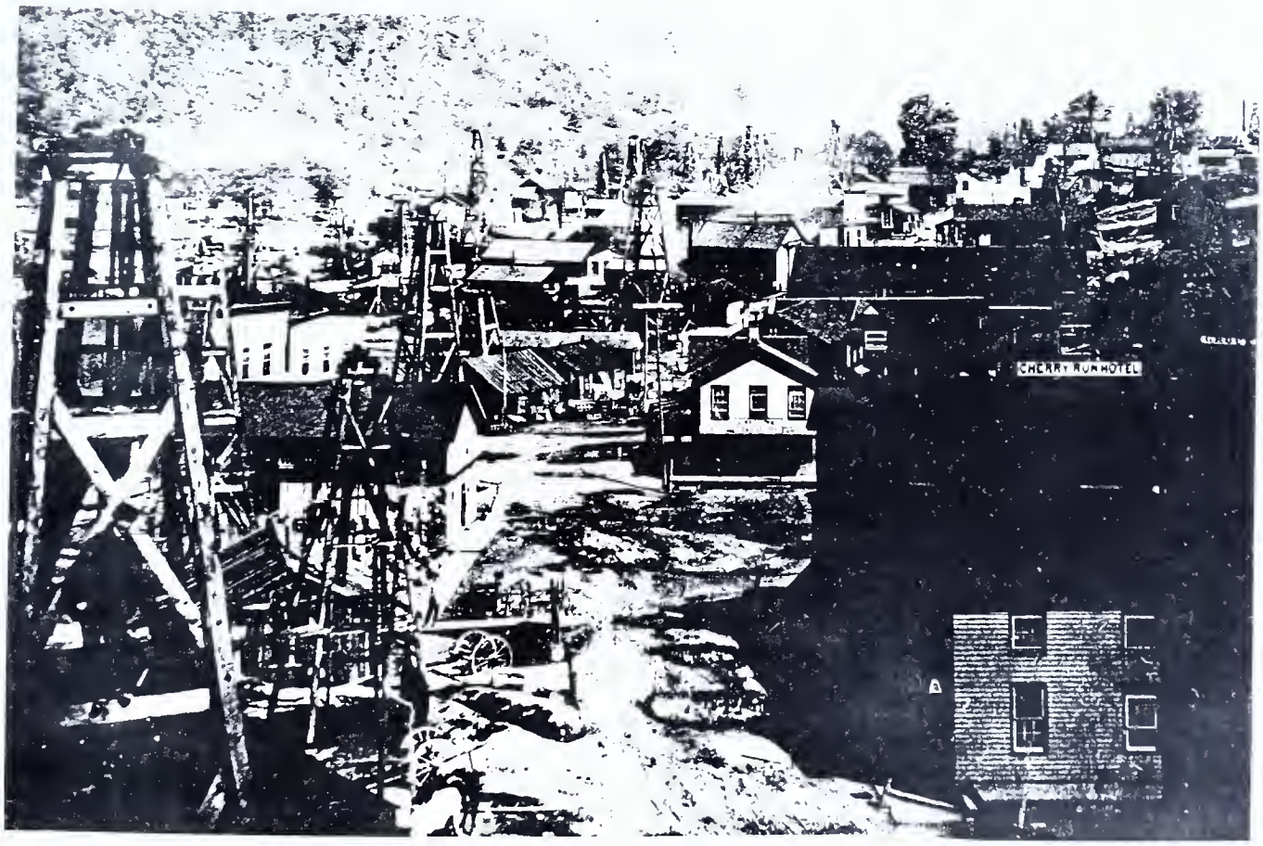
Enter buses and return to Petroleum Center.

Stop VI.	78.2	Petroleum Centre: In 1863 the Central Petroleum Company of New York, organized by Frederic Prentice and George H. Bissell, leased the G. W. McClintock farm of 207 acres, eight miles from Titusville and eight miles from Oil City. The next year the company purchased the farm, drilled a number of wells, and granted leases for one-half of the oil and a large bonus. Excellent wells were drilled. The McClintock well flowed 1,000 barrels daily. The company staked off a half dozen streets and leased building lots at exorbitant prices. Since the town site was halfway between Titusville and Oil City, they called it Petroleum Centre. Surrounded by some of the best oil-producing farms, during the next 8 years most of the worlds oil was produced within a radius of 10 miles, Petroleum Centre was suddenly transformed

PETROLEUM CENTRE
1864

WASHINGTON PETROLEUM CENTRE
1864

BENNING HOFF RUN
1865



ROUSEVILLE

HUMBOLT REFINERY D 1
Plumber, Pa.

POI Mileage

into a lively town with 3,000 people, a bank, two churches, a theatre, a half-dozen hotels, a dozen dry goods stores, three or four livery stables, saloons, gambling dives, boarding houses, and scores of offices for brokers, shippers, and producers. With the influx of all sorts of people and an absence of government, the town soon eclipsed all others in wickedness. President Grant visited here on September 14, 1871, and was given a big reception at the Central House, a large hotel located next to the railroad station. On September 16, 1869, there were more voters registered here than in any city or borough in Venango County. The McClintock farm produced more than five million dollars in oil. One hundred thousand dollars was offered for a 10 acre lease and one-half royalty. There were seven refineries here in the early days. In 1959 many small wells continue to pump.

Today many cellars, the steps to the Bissell bank at the corner, the cellars to the churches on the hill and the cemetery can still be seen.

78.4 Churches and cemetery of Petroleum Centre on hillside to left of road.

6 A 78.7 Benninghoff Run: Up Oil Creek between 1860 and 1866 many great wells were "kicked in" and drilled. The Sherman, Noble and Delemator, Caldwell, Empire, Buckeye and many others virtually tapped lakes of oil, some flowing 3,000 barrels daily. From Petroleum Centre to Miller Farm, a distance of 4 miles, both sides of Oil Creek were built solid with buildings and derricks. In this four miles were the towns of Funkville, Pioneer, Greggs, Shaffer, Miller and Meredith. The Oil Creek railroad ended at Miller 1862-3. Pomeroy's express packet boat ran the creek from Shaffer to Oil City. Five hundred teams moved supplies and oil.

In the fall of the year 1865 Abbott and Harley built a twin two inch pipeline from this point (mouth of Benninghoff Run) to Shaffer, and of the O. C. Railroad at this date. This third line, and first to operate successfully along the creek was under constant armed patrol. It replaced 400 teams. At 3 A. M. April 20, 1866, the stock tanks, loading racks, and tank cars at Shaffer were set on fire by a mob and the pipeline torn up. The guards fired on the mob killing one teamster. Twenty more were arrested. The oil dump box, into which the barrels of oil were dumped, and the pump station were located on the side hill to the right of the road near the mouth of the run.

Both sides of this valley were filled with derricks during the excitement.

6 B 79.9 John Benninghoff's House: For many years John Benninghoff had wrung a bare subsistence from the stony soil of his farm which lay across Benninghoff Run, Western Run and Pioneer Run. As most of

POI Mileage

the farm was high land territory, operators did not look with favor upon it until the fall of 1865, when a completed well produced 300 barrels. Benninghoff was besieged by others who wanted leases. Small lots were taken at boom prices and one fourth the oil, and shortly a dozen wells were being drilled. Riches were thrust upon John Benninghoff, and soon he had an income of about $6,000 a day. His royalty in November, 1866 exceeded $33,000. Distrustful of banks and bankers, Benninghoff purchased a safe in which he could keep his money at home. One night in January, 1868, burglars entered the house and stole over $200,000. A $25,000 reward remained unclaimed. The safe can be seen at the Drake Museum.

Follow this black top road to Route 8.

82.0 Stop sign: Turn right onto Route 8.

6 C 86.4 Glacial sand and gravel deposits on right side of road. Near the bottom of this hill on the left side of the road the Corry sandstone outcrops.

87.1 Titusville and Crawford County line - Titusville was founded by Jonathan Titus in 1796.

6 D 87.2 Roberts Torpedo: Endowed with an inventive ability, Colonel E. A. L. Roberts, while associated with his brother, W. B. Roberts, in the dental business in New York, made many improvements in dental science and dental operations. On the outbreak of the Civil War, he actively engaged in raising regiments for the Union and forwarding them to the fighting front. In 1862 Roberts was appointed Lieutenant Colonel of the 28th New Jersey Volunteers. In December of that year he conceived the idea of opening up the veins and crevices in oil-bearing rock by exploding an elongated shell or torpedo therein. Failing health compelled him to resign his command and return to this home in New York in 1864. Late in that year Roberts made six torpedoes and an application for a patent was filed. After some delay he started for Titusville to test them. Roberts' efforts to introduce his torpedo met with all kinds of rebuffs; oilmen were afraid that torpedoes would spoil their wells, but Roberts was persistent. In the latter part of January, 1865, he obtained permission to explode his first torpedo in the Ladies well near Titusville, which greatly increased its production, created an immense interest in the torpedo, and demonstrated the success of his invention. From that day on, there was an enormous demand for the Roberts torpedo. Hundreds and thousands were used, and they added millions of dollars to the wealth of the oilmen. Four other individuals claimed patents for the same invention, so it was not until November 20, 1866, that a patent was issued to Roberts as the inventor of the torpedo.

W. B. Roberts, brother of E. A. L., furnished most of the money used in developing and testing the torpedo and received a half interest

POI Mileage

in the enterprise. In the spring of 1865, he organized the Roberts Petroleum Torpedo Company; the next year he was elected Secretary; and in 1867 he became President.

Oil producers chafing because they considered the price of the torpedo exorbitant, subscribed thousands of dollars to fight the monopoly. An army of "moonlighters" - men who put torpedoes in wells at night to avoid paying Roberts his fee - came into existence. Roberts' agents combed the oil fields, gathered evidence, and hundreds of lawsuits were started. The "torpedo war" became general and uncompromising. Finally, in June, 1880, the United States Supreme Court upheld the Roberts patent and the producers were forced to surrender.

First successful device for increasing the flow of oil by setting off an explosion deep in a well. It was publicly demonstrated in 1865. The nitroglycerin was made four miles south of here along Hammond Run.

87.4 Traffic Light: Turn right off of Route 8 to Drake Well Memorial Park.

88.5 Crossing Oil Creek - turn sharp right and enter Drake Well Memorial Park.

88.7 To left of road is a railroad flat car with two wooden tanks. This was used for the early transportation of oil.

Stop VII. 88.8 Parking area Drake Memorial Park. Mr. A. C. Thompson, curator of the park will act as our guide. We will see the Drake Well, ancient oil pits, and the Drake Museum. See the story of the Drake Well in the front of this log book.

Return to traffic light on Route 8 and turn right onto Route 8 and Franklin Street. Follow Franklin Street to Colonel Drake Hotel.

FIELD TRIP C

by

William S. Lytle

Sunday, May 17

Erosion channel in Penn Dixie limestone mine

Departure: 8:00 A.M. by private cars from Colonel Drake Hotel

Topographic Maps: Titusville, Oil City, Franklin, Hilliards, Mercer, Butler and Kittanning

ITINERARY

Mileage

0 Colonel Drake Hotel, Titusville, Pa. Cars will assemble at North Franklin Street entrance of hotel and head south. The trip from here to mileage mark 73.8 miles in Butler, Pa., will be by Route 8.

7.2 Junction of Route 8 and Route 417.

11.5 Crossing bridge over railroad. Coal Oil Johnny's house in distance on right. Corry sandstone on left.

12.1 Rouseville - Junction of Rt. 8 and Rt. 227. Pennzoil Refinery refines and markets Pennsylvania Grade oils exclusively.

12.8 McClintockville

13.2 Koppers Co. Inc.: Here this company manufacturers a chemical called DBPC. This chemical is an antioxidant which is used minutely in gasolines to control the oxidation in the burning of the gasoline. It is also used in the cooling oils used in electrical transformers to extend the life of the oils from 6 years to 60 years. If the chemical wasn't used in this oil, the oil would break down, form acids and have to be replaced. They also make the chemical DHT which is used in poultry feed to keep it from turning acidic.

13.6 Pennzoil Refinery: This plant operated by Pennzoil but owned jointly with Wolf's Head cracks all the crude used by the two refineries.

14.6 Keep right on Route 8 by-pass. Notice well on right with a two joint standpipe and stuffing box on top.

The Corry outcrops prominently and continuously for about 1 mile at and a few feet above road level in the cliff of Oil Creek Valley along the by-pass.

15.3 Traffic Light: Along the right hand side of the road at this spot there was a hotel in the early days of oil. The hotel was narrow, only one room wide. All the occupants had front rooms.

Mileage

15.5 Cross railroad tracks.

15.7 National Transit Works: In the beginning of oil when the oil was floated down Oil Creek in boats, this spot was the oil docks for transportation of the oil down the Allegheny River to Pittsburgh. Wharves, warehouses and landings crowded Oil City from the mouth of Oil Creek to the Moran House. Barrels filled the warehouse-yards, awaiting their turn to be hauled or boated to the wells, filled with crude and returned for shipment. Loaded and empty boats were coming and going continually. Firms and individuals shipped thousands of barrels daily, employing a regiment of men and stacks of cash.

The United Pipeline was organized in 1873 with shops at Petrolia where they built the oil field pumps. In 1880 these shops moved to Oil City where the oil docks had been. These shops built all the big pumps for the tripple steam pumps used to pump the oil through the pipe lines. These pumps were sold all over the world. This company changed its name to National Transit about 1883. It was owned by the Standard Oil Co. until 1945. The company transports the crude oil from the oil lease stock tanks to their refineries. The shops keep their pumps in operating order and manufacture new pumps for sale.

As we leave Oil City the Corry will slowly dip below the level of the road and we will be traveling on top of it as far as Reno.

17.9 On the far side of the river are a number of concrete piers on which wells were drilled in the early days.

We will be in Pocono rocks until we climb above them at Franklin. The hills bordering the Allegheny River are capped with Pottsville rocks.

Here on both sides of the river the wells are producing from the Second Venango sand. These wells are in the Oil City-Rouseville pool described under point of interest 5 H of Saturday's trip.

18.3 Wolf's Head Oil Refining Co. Inc.: This company produces, refines and markets Pennsylvania oils exclusively. The largest part of their crude comes from the Bradford District. The rest from the Middle District. They own and refine all the Franklin Heavy crude oil. This crude oil is produced only at Franklin from the Venango First sand. The crude oil is very high in lubricating oils and its producers have always received 50 to 75 cents more a barrel for this crude. This refinery is the oldest refinery in the world under continuous operation in the same location. The refinery is 80 years old this year. The crudes are cracked at a plant operated by Pennzoil but owned jointly by Wolf's Head and Pennzoil. The oil is refined by Wolf's Head exclusive Tri-ex refinery process. This means the oil is put through three extra refinery steps. The capacity of the plant is 2500 bbls. of crude daily. The refinery produces automotive oils, waxes, petrolatum, outboard

marine oils, aviation oils, and gasoline. The gasoline is marketed within 100 miles of the plant while the lubricating oil is marketed world-wide.

19.5 Oil wells on right side of road are producing from the Second Venango and Red Valley sands.

20.8 Prospect-Hill Farm: On the hill on the opposite side of the river stands a large home built by Hon. Charles Miller, President of the Galena Oil Works of Franklin. This farm of 1,000 acres was owned by Mr. Miller and Hon. Joseph Crocker Sibley, President of the Signal Oil Works. In the late 1800s this farm was one of the largest, best equipped and most favorably known in the world. At Meadville, Pa., on one of their farms was stabling for two hundred horses and the finest kite track in the United States. This property is now owned by a Catholic organization.

21.2 Atlantic Refinery: For the next mile on both sides of the road is the former location of the Atlantic Refinery known as the Eclipse Refinery. This refinery was organized by Dr. Tweddle in 1872. It was the largest in the world for some time. It was later moved to Arco, Texas following the discovery of great quantities of oil in that state.

Oil City sand and gravel company to left of road. Sand and gravel is dug from river bed with shovel on a highline.

Socony Mobil Oil Co.: This company has been operating the plant since 1924. Before this it was the Franklin Railway Oil Co., which made car oils and railroad lubricants. This plant doesn't refine crude oil but gets the refined Pennsylvania crude stock from the nearby refiners and processes the oil into dairy waxes, laminating waxes, tanners waxes and oils in the automotive industry and steel mills.

Horizontal Well: One mile to the right of Route 8 past the Socony Mobil plant is the Horizontal Well. This well is now owned by Wolf's Head Oil Refining Co. Inc. The project was a corporation project of the Venango Development Corp. The 8-foot-diameter shaft was started on May 4, 1942, and the work on the shaft and chambers were completed November 15, 1942. The shaft was sunk to a depth of 370 and lined with concrete. A 27-foot-diameter work chamber was excavated in the oil-bearing formation. The walls, floor and roof of the work chamber are lined with 18 inches of concrete. Three rows of 6-inch-diameter port holes, 24 to a row, were cast in the concrete walls of the chamber at depths of 391.3, 407.0, and 419.5 feet below the collar of the shaft to provide openings through which the horizontal holes are drilled. The total depth of the shaft is 428.8 feet. An elevator is used for transportation from the surface to the work chamber. A number of wells were drilled horizontally from the work chamber into the First Venango sand. These wells are still producing. The oil production is the Franklin heavy oil.

22.2 Office of Atlantic Refinery: The Wayside Furniture was formerly the office of the Atlantic Refinery.

Mileage

The Franklin Heavy Oil field is an extensive area characterized by the type of oil produced from it. This field is not a continuous producing area, but all First Sand oil within its limits is several degrees lower in gravity than the oils of the other Venango Sand fields. This "heavy oil" is about 31° A. P. I. and bright green. It is especially valuable because of the large percentage of high-grade lubricating oil that it contains. It is lower in the percentage of gasoline than the other Venango Sand Crudes. It is distinguished also by having a paraffinic base and napthenic light fractions. It is classed as an intermediate base oil by the U. S. Bureau of Mines.

The discovery well of this field was drilled late in 1859. Oil seeps in the bed and along the banks of French Creek at Franklin had been known and utilized long before the drilling of the Drake well at Titusville in 1859. Immediately following the successful completion of the Drake well, Mr. E. Evans, encouraged by an oil seep on his Franklin property, deepened his water well. Oil was struck in a crevice at 72 feet and, when tubed, his well produced, by hand pumping, 10 to 15 barrels of oil daily. This well,which was located on the west bank of French Creek opposite The Point, about 200 yards to the right of the bridge, was the first productive well in this area and the third in the Venango district.

The Evans well made Franklin one of the early scenes of intensive development. In 1861, before the area was thoroughly tested, development here was stopped abruptly by the drilling of flowing wells along Oil Creek. A second period of development starting about 1869 reached its peak before 1875. Drilling, which occurred periodically throughout this period, was particularly active from 1878 to 1880 and from 1890 to 1910.

The first sand, the producing horizon of this field, is predominantly coarse-grained sandstone and conglomerate. It ranges up to 85 feet thick. Although commercially productive in less than half the surface area of the field, the First sand here is rarely totally devoid of oil. Drilling has proved that no large pools occur within the non-productive portions of the field. In these non-productive areas the sand is generally thin, tightly cemented, and contains water.

Except for a gentle south-plunging anticline between Wyattville and Oak Forest School and a gentle syncline east of this school, the structure of the sand is a fairly uniform south regional dip. In this field, as in most of the Venango district, the localization of oil accumulation has been influenced much more by the sand conditions than by the structure.

This field is located north of the old Atlantic Refinery site. The entire production is now owned by the Wolf's Head Oil Refining Co. Inc. Formerly producers were paid an additional 75 cents a barrel for this oil due to the large percentage of lubricating oil that it contains.

Mileage

23.0 Franklin: As we cross the bridge over French Creek and enter Franklin, we see exposed on the high cliff to our right almost the entire section of the Cuyahoga Group. This group lies between the Shenango Formation and the older Corry sandstone. The top of the Corry here is about at river level. The Cuyahoga Group is approximately 150 feet thick and consists of alternating beds of shale, sandstone, and sandy limestone. It becomes increasingly sandy upward and grades into the Shenango above.

The upper half of the Cuyahoga Group of this area is the approximate stratigraphic equivalent of the lower Meadville and the Sharpsville Formations of Crawford County. Very fine-grained yellowish- to reddish-brown sandstones predominate in this upper part of the group. Interbedded with these sandstones are gray to brown sandy shales. Although locally continuous and sharply defined, the individual members can be identified in isolated outcrops only by intervals to other horizons. Both lateral and vertical gradation occur between the sandy shales and argillaceous sandstones. Local lenses of sandy limestone occur at several horizons, especially in the northwestern part of the quadrangle. These limestones are sparingly fossiliferous. Upon weathering they leave a compact brown sand mass that is not readily distinguished from a non-calcareous sandstone.

The lower half of the Cuyahoga Group is the approximate stratigraphic equivalent of the Orangeville shale of Crawford County. In this area gray to brown shale predominates in this lower part of the group. These shales range from argillaceous to arenaceous. Fine-grained, yellowish- to greenish-gray, flaggy sandstones and siltstones up to five feet thick occur at several horizons through this part of the section. Locally these sandstones, and less frequently the shales, are highly calcareous and grade laterally into layers of siliceous or argillaceous limestone. Here four of these highly calcareous siltstones, or silty limestones, ranging up to two feet thick, are developed in the interval extending from 45 to 60 feet above the Corry sandstone. This is the general horizon of the Meadville Lower limestone of Crawford County. Thin layers and concretionary masses of siderite are well developed in the darker shales of the lower part of the Cuyahoga Group.

Franklin Forts: Four tenths of a mile south of Route 8 along the Allegheny River is the side of Fort Venango. It was built by the British in 1760 to assert control of the area. Indians attacked and destroyed it in 1763 during Pontiac's uprising.

Near this site is the site of Fort Machault, a French fort, built in 1754-55 to guard the route to the Ohio. In 1759 French forces massed here to retake Fort Duquesne. On news of the fall of Fort Niagara they burned Fort Machault and fled.

Franklin Refinery: A crude oil refinery in Franklin is a division of the parent company, L. Sonneborn Sons, Inc., of New York. Three manufacturing plants comprise the Sonneborn organization. The largest of these

plants is the Daugherty Refinery located at Petrolia, Pa., approximately 40 miles south of Franklin. This plant is devoted entirely to petroleum specialties and ranks as one of the largest producers in the world of white mineral oils, petroleum sulfonates and microcrystalline waxes. The Russians produced most of the white mineral oils until the research staff of Sonneborn discovered the refining process which it uses today.

The Franklin Refinery, Amalie Div. of L. Sonneborn Sons, Inc., is a combination lubricating oil-petroleum specialties operation. They distill Pennsylvania crude oil from which is produced lubricating oil of 100% Pennsylvania quality. One hundred percent Pennsylvania lubricants have been the accepted standard of quality ever since petroleum refining was started 100 years ago. Further refining of the other fractions of the crude, not going into lubricating oil, into specialty products is one of the main functions of this plant. This plant produces petrolatum (trade name "Vaseline"), which is used in cold creams, salves, medicinal compounds, protective coatings, etc. The majority of the petrolatums produced by this company must meet the so-called U. S. Pharmacopoeia characteristics. This means that these petrolatums are suitable for internal use and, therefore, no foreign substance of any kind can be added without the explicit permission of the U.S.P. Other products of this plant are microcrystalline waxes used for paper coatings, lamination, and dip waxes in the meat industry. Also Heavy Duty oils are produced. This plant was the first lubricating oil company in the world to develop and use depressants.

The third plant is located in Belleville, New Jersey.

Early Refineries in Franklin: Mr. Charles Miller of Franklin perfected a method to manufacture lubricants from crude oil. He also discovered the value of Galena, a lead oxide, as an ingredient in lubricating oils and patented the process. He organized the Galena Oil Works in 1870. This oil works supplied most of the oils used by railroads for many years.

Mr. Joseph C. Sibley, after a number of years experimenting with oil used in valves and cylinders of locomotives, discovered the Perfection Valve Oil which was used by most of the locomotives in the United States for many years. He also made Perfection Signal Oil used in railway lamps and lanterns. Mr. Sibley organized the Signal Oil Works in 1869 and catered to no other than railroad trade.

Just 300 yards above the bridge and opposite the Evans well, a well was drilled on the high cliff. As the bit was penetrating the formations at creek level the bit swung free. The tools were hauled out and the bailer run. When the bailer was dumped the fluid had an odd smell. The driller tasted it and discovered it was beer. Just then an excited man came running up the hillside and told them they had drilled into a cave where he kept his beer in large barrels and their bit had penetrated one of the barrels. The barrel was moved aside and the well was continued to the oil sand and became a productive well, of oil that is.

Mileage

23.1 Second Traffic Light: Turn right at Washington Cr. and Liberty. Continue to follow Route 8.

23.3 Pa. Dept. of Highways: This large yellow brick building was formerly the office building of the Galena Oil Works.

23.8 Blinker Light: Turn left at Liberty and 15th Streets. Continue to follow Route 8.

25.1 Bear right on Route 322 and Temporary Route 8. We have climbed above the Mississippian rocks. The occasional large boulders we see are Conoquenessing sandstone.

29.4 Town of Polk: State Institute for feeble minded. Turn left. Follow Temporary Route 8.

32.4 Turn right onto Route 8. As we descent into the valley of Sandy Creek large boulders of Connoquenessing and Burgoon sandstone will be seen on the hillsides.

34.2 Crossing Sandy Creek.

39.5 Junction of Route 8 and Route 308.

40.9
41.7 Clarion coal stripping operations. We are now in rocks of Pennsylvanian age Allegheny group.

43.8 A glacial sand deposit. For a number of years this sand was used to make cement blocks.

45.9 Barkeyville: Junction of Route 8 and Route 208. Due east of here is the western edge of the Bullion-Clintonville field. Production is from the Second and Third Venango sands. The area covered by the Second sand is twice that of the Third sand. The Second sand varies from a fine-grained sandstone to a coarse and pebbly sandstone. The porosity is about 20 percent with the permeability less than 10 millidarcies over most of the main field. Air-gas drive and water flooding are being operated successfully in this field. The highest initial production in the early days was 3,500 barrels per day. The Martin well discovered the field about 1860 with an initial production of 1,000 barrels per day.

46.9 Vanport Limestone: Outcrop of Vanport limestone on the right bank of the road at the top of the rise. About 7 miles east of this spot the Vanport limestone is mined at Anandale. The Pittsburgh Limestone Company operated, until 1958 when it was shut down, a large limestone mine at Anandale with a capacity of about 3,700 tons per day. The section is as follows:

Mileage

	Ft.	In.
Shale		
Limestone, gray	3	0
Parting, rock taken to this point at times		
Limestone, gray	2	0
Parting, rock usually taken to this point		
Limestone showing banding	3	0
Parting		
Gray stone, best grade	4	0
Parting		
Limestone, gray	3	0
Parting		
Bluish limestone	2	8
Parting		
Bluish limestone, left for floor	1	4
Fire clay	1	4
Coal		1 to 2

As shown above, the limestone is 19 feet thick at this point although it has some variation. Of this, 12 feet 8 inches is usually removed although occasionally the overlying 2-foot bed is also mined.

The limestone was used for flux at the United States Steel Co. plant in Pittsburgh.

50.1 Harrisville (Rest stop): Junction of Route 8 and Route 58 and 338. Park your cars in the parking space on the left side of the road at the restaurant called the "Spot". Route 8 parallels the Wisconsin Terminal moraine which lies to the west.

This area was a natural clearing when white settlers first came to Butler County. The Indians planted their corn in this area.

51.3 Montgomery Block Works: This plant is built on a fluvial outwash plain formed by glacial outwash. This deposit is about 50 feet thick and is composed of sand and gravel.

52.0 Pipe Line Crossing: In 1879 a 5-inch crude oil pipe line was laid from Butler County to Cleveland, Ohio, by the Standard Oil Co. In 1880 crude oil from the Bradford field came down through Kane to Butler County and then through this 5-inch line to Cleveland. Today there are three 8-inch lines, two 6-inch lines, and the old 5-inch laid in this right-of-way. The oil is now pumped from the Illinois fields to Bear Creek in Butler County, to Kane, and to Buffalo to the Socony Vacuum Frontier Refinery. The pipe lines are now owned by Northern Pipeline Co. and handle about 100,000 barrels per day.

A couple of miles west of this point is the location of the Jessie G. Hockenberry well No. 1 drilled by Manufacturers Light and Heat Co. This well was

Mileage

drilled to a total depth of 10,096 feet and finished in the Gatesburg sandstone of Cambrian age. The well started in the Pennsylvanian. A show of gas in the Trenton and Gatesburg and a show of salt water in the Gatesburg were encountered. The well was abandoned as a dry hole.

53.1 Junction of Route 8 and Route 108.

53.4 Road Cut: Lower Kittanning coal in cut. The Middle Kittanning coal is mined extensively in the area.

53.8 Limestone Mine: In the distance on the left side of the road a mine in the Vanport limestone can be seen.

55.7 Oil Field: This small oil field is producing oil from the Venango Second sand.

56.2 to 57.8 Slippery Rock Creek: We are traveling here parallel to Slippery Rock Creek. Ponded blue clay deposits can be seen in road cuts. These deposits were laid down during the maximum advance of the Wisconsin ice when the waters of this creek were dammed up by the ice, forming Glacial Lake Arthur. (More on this at Stop I.)

59.0 Old Stone House: Junction of Route 8 and Route 78 and 528. Continue on Route 8.

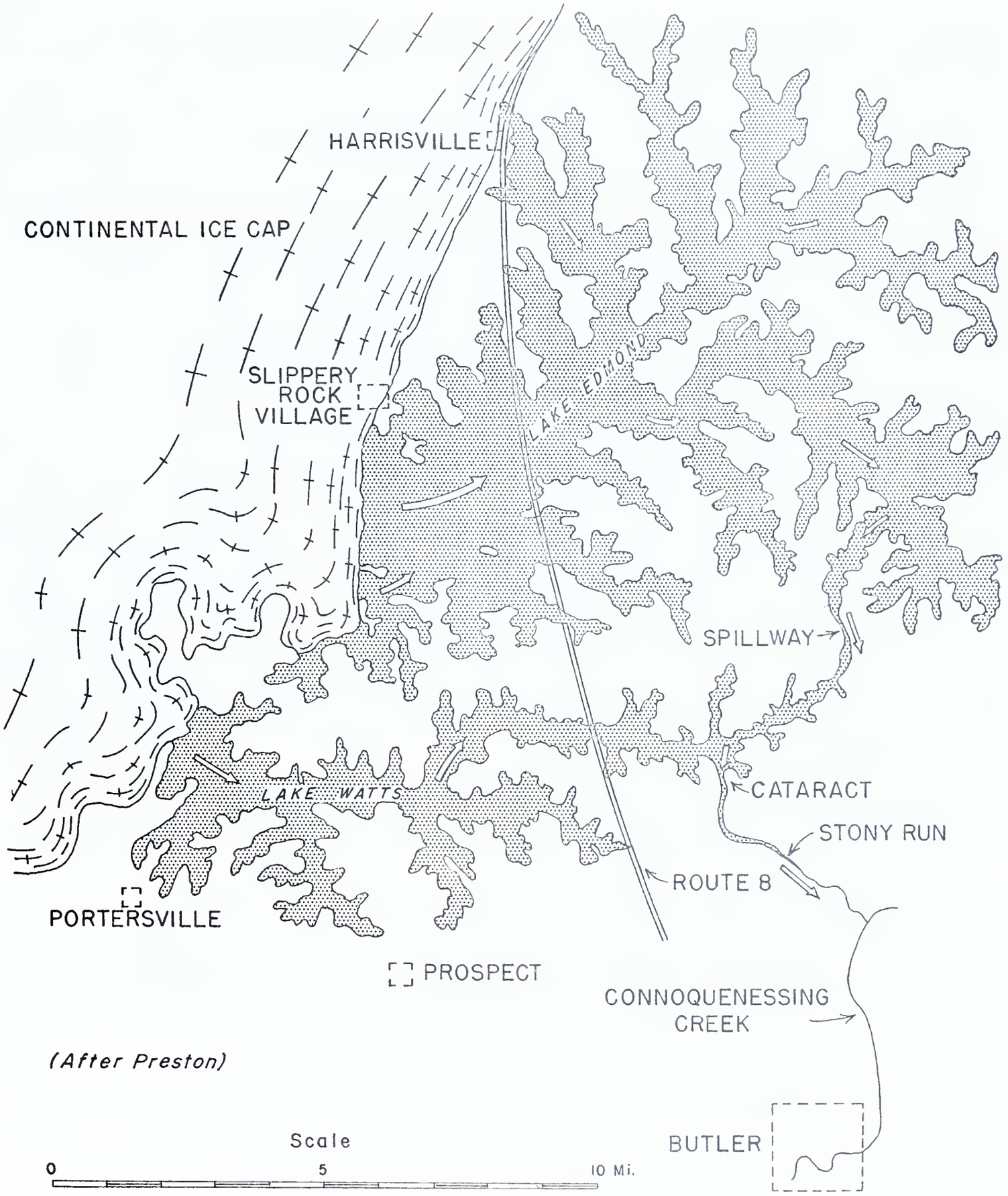
Note Old Stone House on the left. It was an Inn in the early days. The last Indian massacre in Butler County occurred about two miles north of this Inn. An intoxicated Indian was refused lodging at the Inn and spent the night in the woods. The next morning he attacked and killed a mother and her children. He was later hung at the Butler County Court House.

The neighboring wet prairie is famous for its acres of "blazing star" flowers. We are north of the divide between the Slippery Rock and Muddy Creek drainage that separated Lake Edmund from Lake Watts (Fig. 8). To the north Slippery Rock Creek and its major tributary valleys are filled with glacial outwash. The deposits coarsen from clay near here to coarse sand and gravels about five miles to the north and northwest, nearer the glacial ice front source. (More on this at Stop I.)

59.2 Mine in Middle Kittanning coal left side of road.

61.4 Spring from Freeport sandstone, left side of road. We are near the top of the Allegheny Group.

62.5 Stop I, Glacial Lake: Our present location is at the eastern tip of Lake Watts where Route 8 crosses this tip. Figure 8 shows the approximate edge of the maximum advance of ice.



SPLITTING OF THE LAKES AT MAXIMUM ADVANCE OF ICE

Fig. 8

As the ice advanced, pondings began to develop on a big scale. The area now occupied by the Wolf Creek drainage would become a very sizeable lake, with ramifications into the valleys of the present Slippery Rock and Muddy Creek drainages. This ponding we have called Glacial Lake Arthur, in memory of our recent ranking geologist, Edmund Watts Arthur.

There is a possibility that the outlet of this lake was at first down the channel of the present Slippery Rock gorge, which may indeed have served as a discharge route in Illinoian times, but the continued advance of the Wisconsin Ice blocked this outlet. No doubt some water escaped from under the ice, but some had to look for another outlet, which it found at Queen Junction, into the valley of Stoney Run and thence into the Connoquenessing.

The ice advance was now very close to maximum, and at about the same time the ice dammed against the Mahoning Sandstone hills that divide the Muddy Creek and Slippery Rock drainages. This splitting of the lakes produced Lake Edmund in the Slippery Rock drainage and Lake Watts in the Muddy Creek drainage. The levels were not alike. Lake Edmund was at 1310 feet or thereabouts; Lake Watts at 1260 (though it may initially have been somewhat higher). The higher lake flowed into the lower through the West Sunbury pass, far to the east, at a level of 1310 feet.

Erosion at the Queen Junction pass seems to have been by a waterfall, which cut the divide back northward perhaps half a mile and may have reduced its height considerably. At the end its elevation was about 1260 feet, as mentioned.

Vast quantities of gravel, sand and mud were poured into Lake Edmund, which was filled completely full; i.e., to 1310 feet, in all the valleys draining from the ice front. Here the deposits are largely gravel.

The main valley was not filled, but underwater alluvial fans sloped steeply down at the deboucheres of the minor streams into the main valley. Here we still get gravel. A mile or less away the most we get is pea-gravel, and most of the time what we get is sand, with an occasional layer of clay. The deposits are solid enough to carry buildings and railroads and highways.

In the valley of Muddy Creek conditions are different. Very fine silts, extremely plastic clays in fact, backfilled the valley to a great depth. At Isle they are reported to be 70 feet thick. On the top of these is a few feet of sand and post-glacial material. The sand cover is thicker at the western end of the valley, and it is not post-glacial. Close to the ice-front we have perhaps 8 inches of clay resting directly on the Pliocene floor of Carboniferous rocks, and then up to 70 feet of sand, including pea-gravels. At Isle we have 70 feet of clay followed by 3 feet of silt, possibly post-glacial in whole or part. At Route 8 we have 12 feet or more of clay, and 2 or 3 feet of silt including sharp sand grains. A few miles east of this, at a level of 1240 feet, we have 2 or 3 feet of silt, and 6 feet of clay.

Mileage

The logical interpretation is that Muddy Creek was ponded in such a way that little water reached it except by way of Lake Edmund, and that Edmund trapped the heavier silts, while only the finest rock flour reached Lake Watts. However, as the ice advanced, the western end of Lake Watts began to experience an influx of sand and even pea-gravel.

The sill at Queen Junction had been worn back and down till it stood at 1257 feet when the ice began to back off. A retreat of about a mile opened an outlet in the west, across the Perry Highway to the Lower Slippery Rock. This outlet is at 1237 feet, 20 feet below the Queen Junction sill. This we have called Alpha Pass. The form of this sluiceway shows that while it was operating, there was a clear outlet to the south at a level not higher than 1140 feet. It follows that the back of the old divide, which was originally at about 1300 feet, had been broken before the retreat of the ice. This may have been done during the ice advance, or it may have been done in pre-Wisconsin times altogether.

Alpha Pass dropped the water level 20 feet, and it may have been only a few days in doing it. Theoretically 24 hours would almost suffice. Then the ice retreated another mile, and Beta Pass opened, dropping the level another 8 or 10 feet to 1230 feet and leaving Alpha dry. A retreat of another mile or less opened Gamma Pass, the present outlet, but Muddy Creek could not take full advantage of it. Its old outlet had been plugged with gravel and sand by a barrier extending to about 1220 feet. A new outlet was available at 1180 feet, over a sill of the Vanport Limestone at Portersville Station, along the edge of the moraine. Thus a remnant of Lake Watts persisted, choked nearly full of mud and sand. These are now the flats of (Butler County's) Big Run and Muddy Creek. In post-glacial time the Vanport Gorge has been cut down another 30 to 40 feet, but the sill is still far above the Pliocene floor, which is probably well below 1100 feet.

65.2 Terrace Drive-In.

66.5 to 68.7 Between these two points we will pass over the siltstones, shales and coals of the upper part of the Allegheny Group and the lower part of the Connemaugh Formation.

68.7 Junction of Route 8 and Route 308.

72.4 Top of hill north of Butler, Here we are in the Mahoning sandstone and shale of the Connemaugh Formation. As we descent the hill we cross the Upper Freeport coal which is the top member of the Allegheny Group.

73.5 Junction of Route 8 and Route 422. Continue on Route 8.

73.7 Butler County Court House: Court House on the right has just been cleaned by sand blasting. This building and many others here are built of Butler sandstone, occurring between the Upper and Lower Freeport coals in the Allegheny Group, which is quarried locally.

Mileage

The Upper Freeport coal lies about three feet below the surface of the highway.

73.8 Traffic Light: Junction of Route 8 and Route 356. Turn left onto 356 leaving Route 8. Continue to follow Route 356.

74.8 Leaving City of Butler.

75.1 Bear left on Route 356.

76.5 Heasley's Nursery: For the next few miles we will be traveling over rocks found in the middle of the Connemaugh Formation.

79.3 Oil Wells: These wells are producing from the Venango Third sand. The pool continues southwest for about one mile to Jefferson Center where there were a number of large wells in the early days. Due west 4 miles is the Thorn Creek field. The Armstrong No. 2 well in this field was the second largest producer in Pennsylvania. Its initial production was 10,000 barrels the first day.

Stop II.

82.7 "Uncle Billy" Smith's Grave: William A. Smith, familiarly known to oilmen as "Uncle Billy" Smith was born on February 5, 1812 at Hubb Run, Butler County, Pa. He lived and worked in the vicinity of Pittsburgh and Tarentum. By trade he was a blacksmith, toolmaker, and a salt well driller. In April of 1859 he accepted an offer from Col. E. L. Drake at $2.50 a day to drill a well for oil near Titusville, Pa. He made the drilling tools by hand in his blacksmith shop at a cost of $76.50. On August 27, 1859, the well came in at a depth of 69 1/2 feet.

83.4 Turn left toward Cabot, leaving Route 356.

84.4 Cabot: Godfrey L. Cabot, the wildcatter, drilled his first gas well here in 1888. This well was drilled in the chicken yard in back of the beer hall. To use his gas he built a Carbon Black Factory on this ground which made 2500 pounds of carbon black a week.

85.1 Winfield Elementary School: The flagpole is stuck in the casing of an old well which had produced gas from the Thirty Foot and Speechley sands.

88.3 Entrance to Butler County Mushroom Farm, Inc.: The Butler County Mushroom Farm, Inc., does business in a mined out Vanport Limestone mine formerly owned by United States Steel. This mushroom farm is the largest in the world in steady production located in one spot. It occupies an area of about 1,500,000 sq. ft., employes 300 men and women, and produces 12 to 15 tons of mushrooms every day for 365 days of the year. Being in a mine it is as dark as possible, without draughts, holds a constant temperature of around 56° F., humidity remains constant, and has a maze of tunnels and working areas. Production is continually climbing due to research. Since

Mileage

its start production has doubled without increasing the working area. It boasts one of the most precise scientific production staffs obtainable. The farm is highly mechanized and produces on a production line basis. The spawn, which is grown in the farm's laboratory, is scattered over the surface of the pasteurized compost which is 50% race track manure and 50% synthetic compost of hay and corncob in 4' x 8' x 6" trays. After 3 weeks one inch of top soil is spread over the trays and picking starts at the end of three more weeks. After 20 days two-thirds of the total output has been picked. The mushrooms are stored in vacuum cooled rooms where the temperature of the mushroom is dropped from 60° F to 33° F in 15 minutes. Thirty-five percent of the production goes to fresh markets while the balance goes to processors such as Heinz and Campbells.

Stop III. 89.0

Penn-Dixie Cement Corp.: Park in parking lot on left side of road in front of plant. Mr. Joe F. Gambill the plant mining engineer will describe the operations. Each person will be supplied with a safety helmet and electric light before entering the mine. If there are more than 50 people on the trip, the group will be divided into two parts since there are only 50 safety helmets available. This is a lunch stop and our final stop. The conference will end with the trip through the mine. In case it is necessary to divide into two groups, the second group will eat lunch and collect fossils while the first group goes through the mine. The trip will take about one hour. Be sure to wear a jacket or sweater into the mine, since the temperature is about 60 degrees and the ventilation system causes the air to move quite rapidly in some sections. The first group will eat lunch after their trip through the mine.

The limestone deposit at West Winfield is called the Vanport Seam, which is a pure and uniform high calcium carbonate that can be traced through several counties of Western Pennsylvania for about a hundred miles with only slight variation in its characteristics. It was named after the town of Vanport and was formerly called ferriferous limestone because of a thin layer of carbonate of iron over the top of the limestone seam. The most common fossils found in the limestone are crinoid stems and brachiopods.

The Vanport deposit at West Winfield lies on the axis of the Kellersburg Anticline which plunges to the southwest at about 75' per mile. The flanks of the anticline slope at about 75' per mile.

The limestone averages about 22' in thickness. The overburden in places is several hundred feet in thickness and for this reason the limestone is mined rather than quarried.

With the exception of gypsum, all the materials that are necessary for the production of cement are available in the mine. The shale used lies immediately below the limestone seam and is mined in the rooms where the limestone has been exhausted. To compensate for the low silica content of this shale, sandstone is added, which is extracted from the mine in areas where the limestone was eroded after deposition of the overlying ferriferous

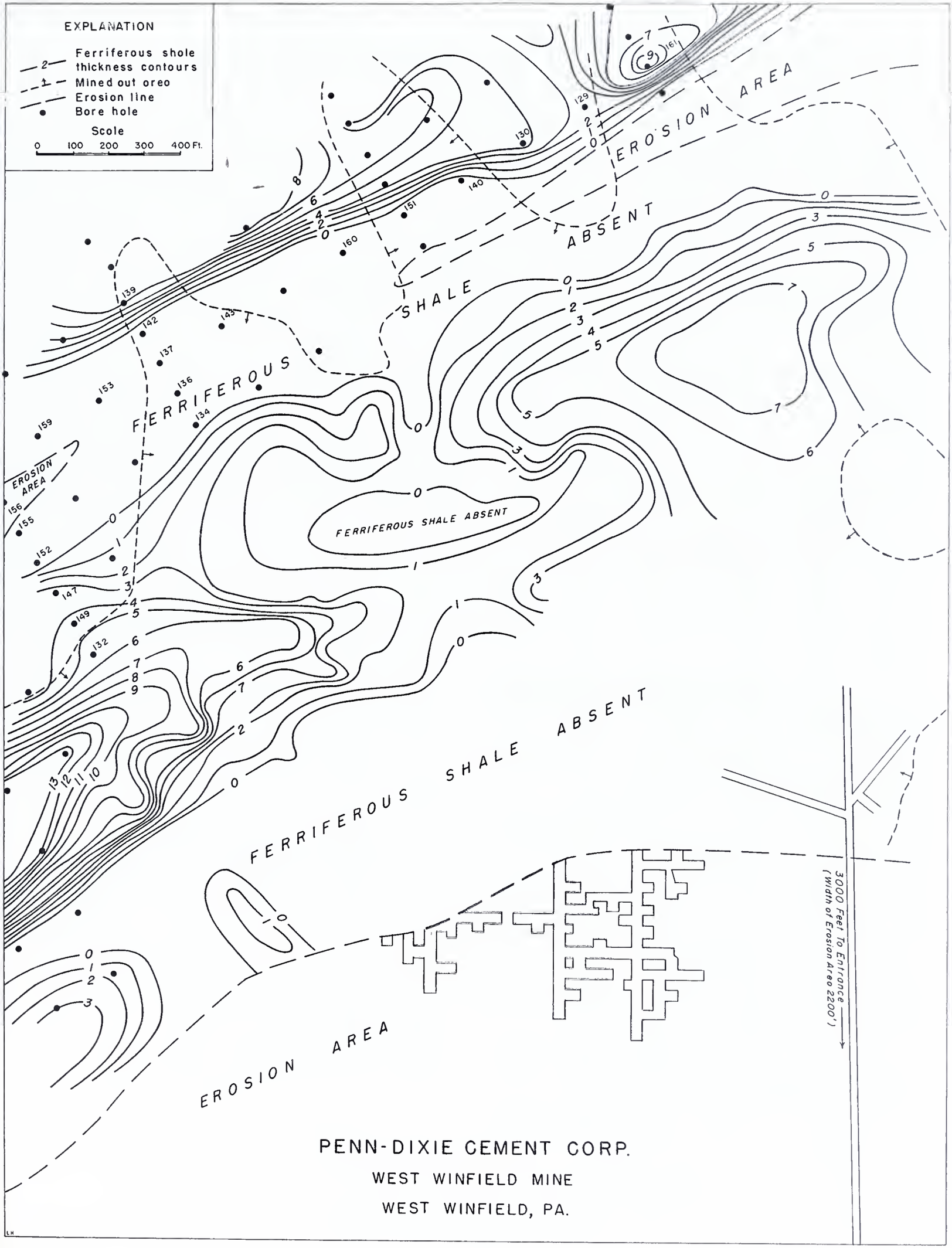
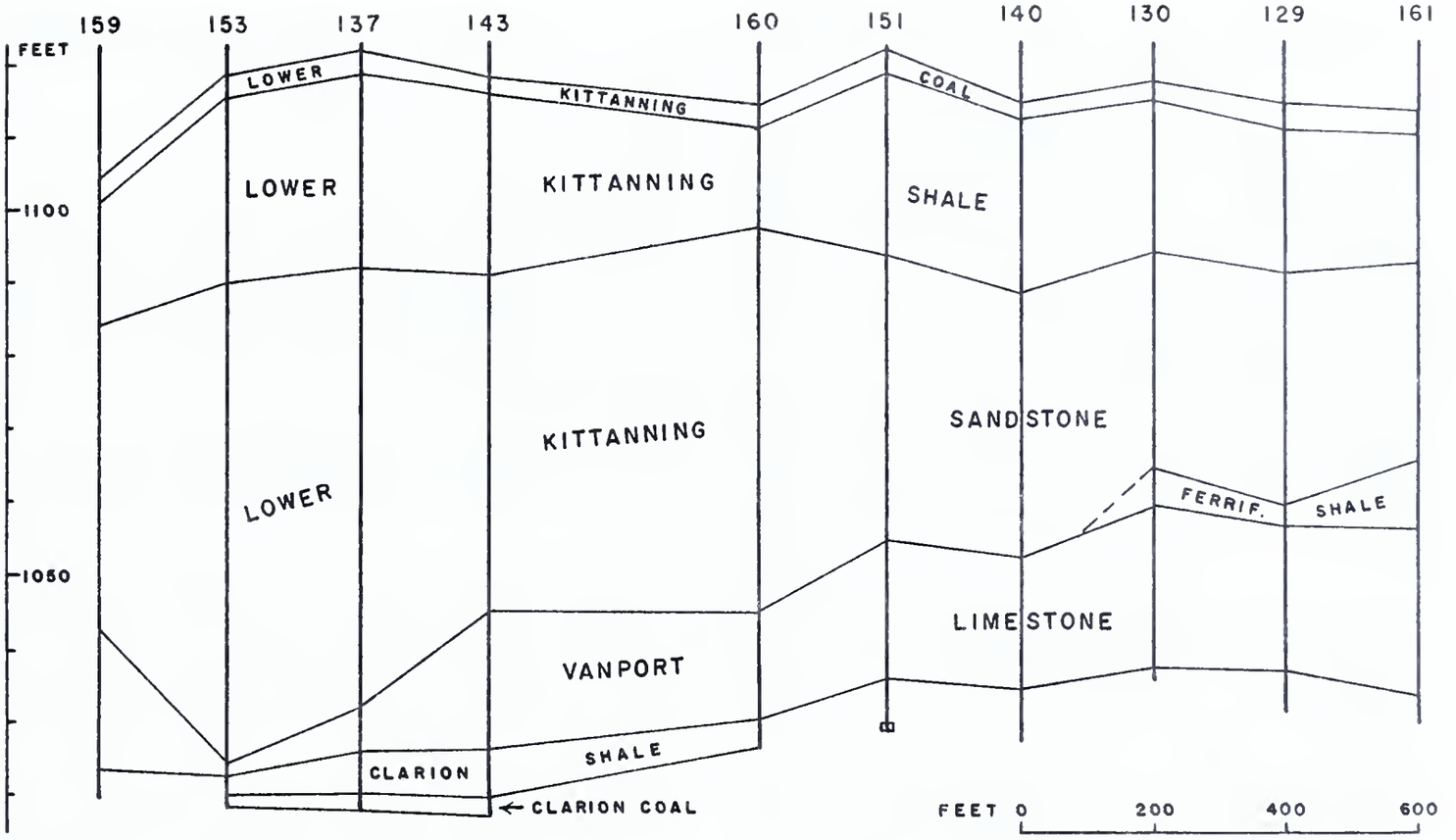
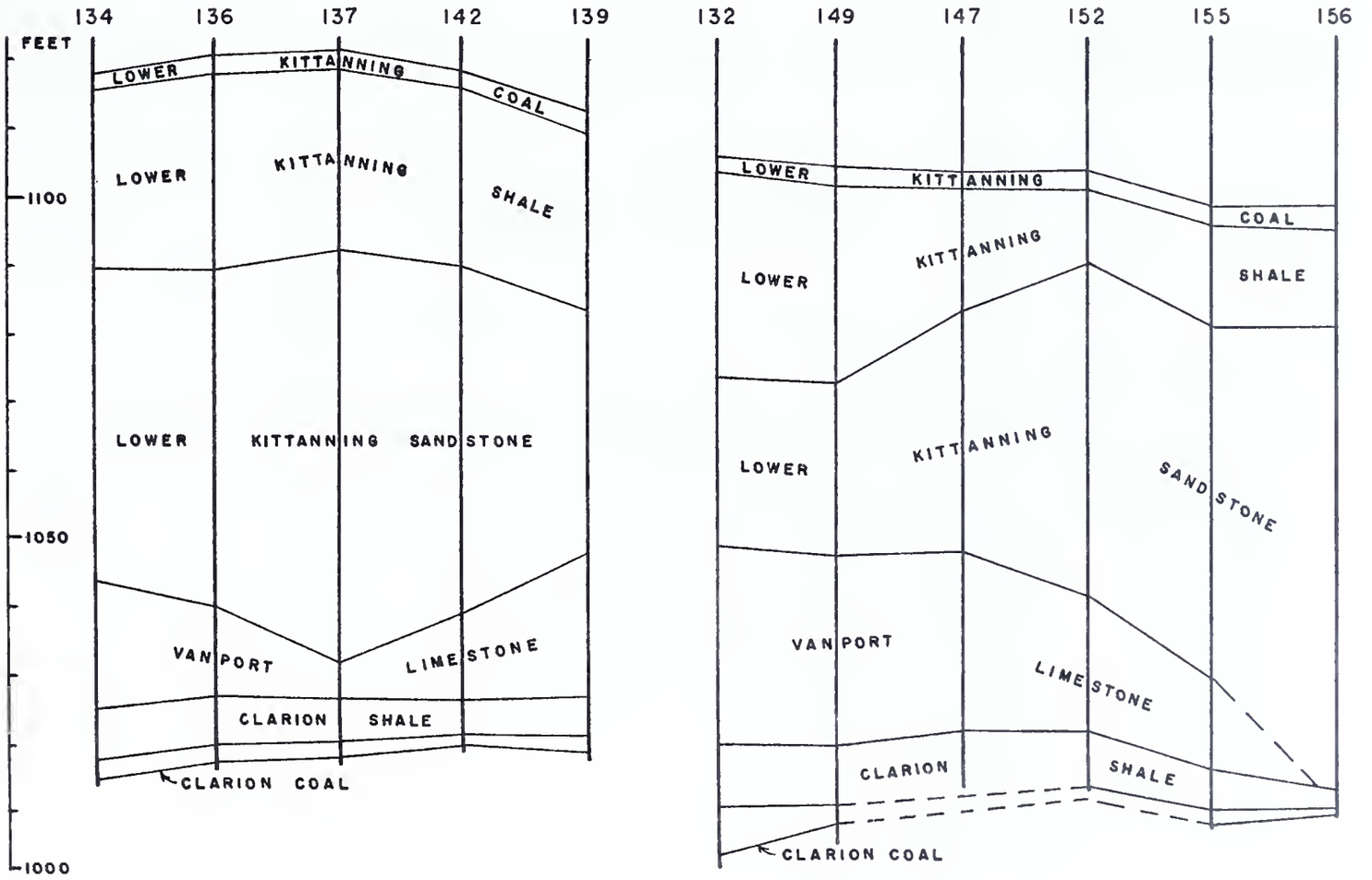

EXPLANATION
Ferriferous shale thickness contours
Mined out area
Erosion line
Bore hole
Scale
0 100 200 300 400 Ft.
EROSION AREA
ABSENT
SHALE
FERRIFEROUS
FERRIFEROUS SHALE ABSENT
EROSION AREA
FERRIFEROUS SHALE ABSENT
EROSION AREA
3000 Feet To Entrance
(Width of Erosion Area 2200')
PENN-DIXIE CEMENT CORP.
WEST WINFIELD MINE
WEST WINFIELD, PA.

Fig. 9





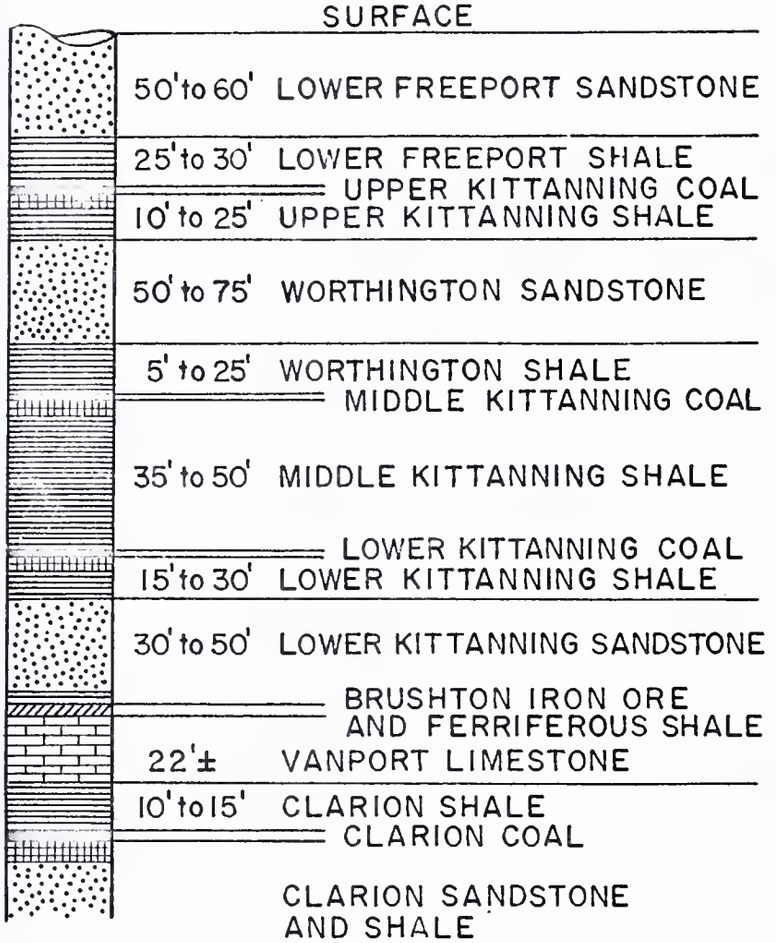
Cross-Sections of Vanport Limestone Mine

Penn-Dixie Cement Corp., West Winfield, Pa.

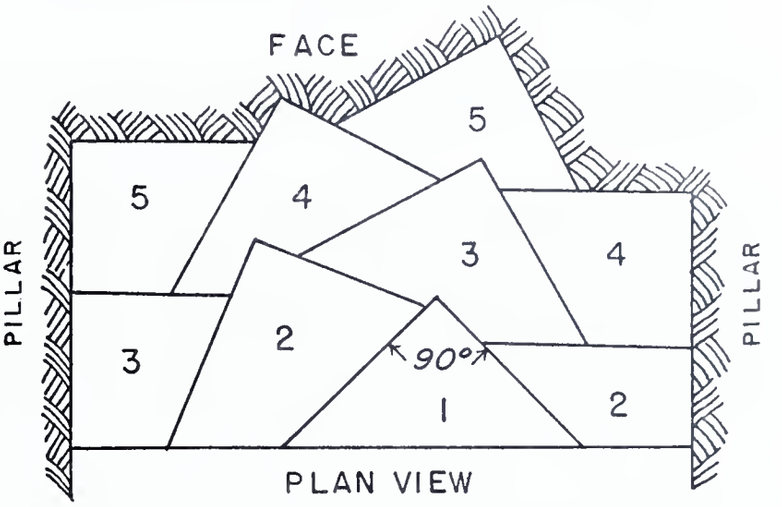
(See map for bore hole locations)

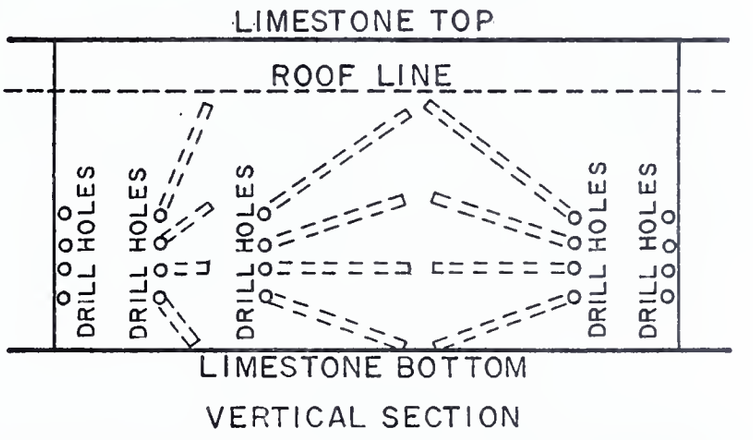
Fig. 10

SEQUENCE OF ROCK LAYERS AT WEST WINFIELD

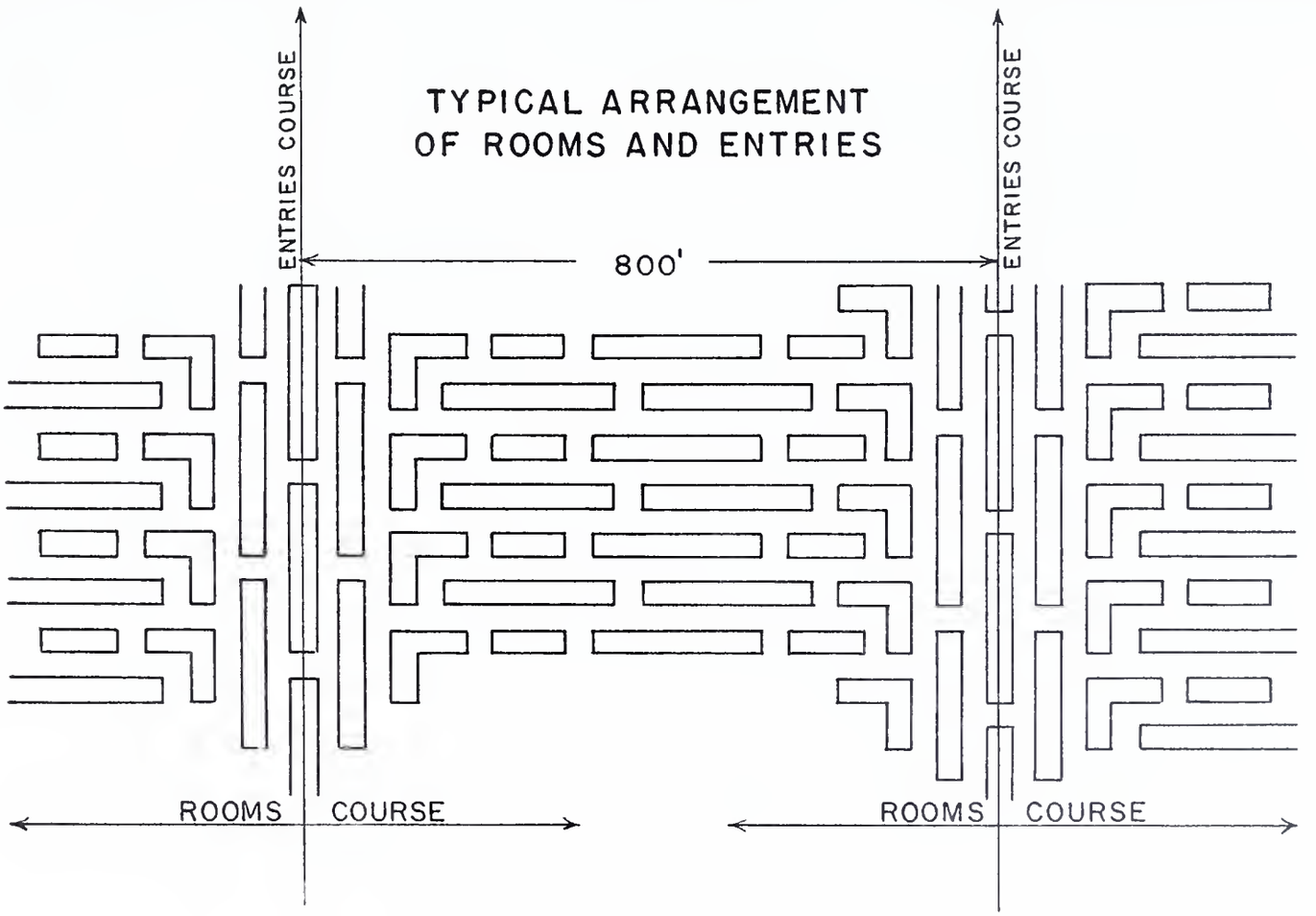


TRIANGULAR BLOCK CUT METHOD





TYPICAL ARRANGEMENT OF ROOMS AND ENTRIES



Vanport Limestone Mine

Penn-Dixie Cement Corp., West Winfield, Pa.

Fig. 11

Mileage

shale, but before deposition of the Lower Kittanning sandstone. See figures 9, 10, 11.

The conventional room and pillar system of mining is used because of the uniform thickness and horizontal stratification of the limestone deposit. Two top layers of the limestone (average thickness of each layer two feet), are left as roof stone, mainly to reduce contamination of the limestone, and because of the ferriferous shale, which generally overlies the limestone seam, will not support itself. Where needed, 3/4 inch bolts with expansion shields anchors the roof.

For safety purposes the overhead D. C. trolley line is guarded where its height above the rail is less than 7 feet 6 inches. HANDS OFF

One of the largest limestone operations in Butler County is this Penn Dixie plant. This is the first place where limestone was mined in Pennsylvania and the second oldest limestone mining operation in the country. The earliest record of limestone mining in the United States is at Lowmoor, Va., in 1883. The West Winfield mine was started in 1894 and has been in operation ever since. It has been worked to supply limestone for flux, for lime and more recently for Portland cement manufacturers.

The section exposed in the hill between Rough Run and Long Run is approximately as given below. The thicknesses vary considerably in different parts of the hill, and in addition, the upper six members have been in part or entirely removed by erosion in places.

Average geological section at West Winfield

	Thickness	
	Ft.	In.
Mixed shale and sandstone	50	
Lower Freeport coal	2	
Fire Clay	4	
Mixed shale and sandstone	53	
Upper Kittanning coal		6
Fire Clay	2	6
Shale and sandstone	50	
Middle Kittanning coal	1	6
Fire clay	2	6
Shale and sandstone	50	
Lower Kittanning coal	3	
Fire clay	4	
Shale and sandstone	40	
Iron ore	1	6
Vanport limestone, mined	25	
Gray limestone, left as roof of mine 3'		
Shale parting		

Mileage

Average geological section at West Winfield (cont)

	Thickness Ft.	In.
Thin-bedded limestone, ("shell rock"), drilled and shot down after removal of underlying massive limestone.....2'		
Gray limestone, uniform in character 13'-15'		
Shale parting		
Bluish to black limestone.....4'-5'		
Shale, for cement, mined.....	16	
Clarion coal, mined at times.....	3	6
Fire clay and shale.....	16	
Clarion sandstone, mined.....	50	
Shale.....	15	
So-called "70 ft." sandstone.....		

The beds are nearly horizontal except in a belt that crosses the property in a general east-west direction and is approximately 2200 feet in width. within this band there is a perfect jumble of blocks of coal, shale, sandstone, and limestone folded and faulted in every conceivable manner. In one place a thickness of 5 feet of Vanport limestone was seen standing on edge with practically a vertical dip.

The cement company has driven a drift through this disturbed area and is mining stone at the far side. Two theories have been proposed for the formation of this disturbed area. The theory that seems the most logical proposes that a large part of the limestone bed was removed by underground solution and the subsequent collapse of the roof formed the complicated structure. The second theory proposes that an erosion channel was formed in the limestone before the beds on either side of the channel had been compacted. These beds slumped into and filled the channel. If this happened it would mean that the beds overlying the limestone, adjacent to the channel, would be disturbed and the interval filled with younger material. Drilling in this area has shown only the normal sequence of beds. This disturbed area is the one we are going to walk through by using the drift driven through by the cement company.

Other erosion areas are present in the mine. These are different than the one described above. Erosion in these areas took place after deposition of the ferriferous shale and before deposition of the Lower Kittanning sandstone which completely fills the erosion areas.

Notice the plant fossils on the roof of the drift and the evidence of slickenside at many places.

In the early days the ferriferous shale was used locally in the old iron furnace which can be seen about 1,000 feet down the railroad track below the cement plant.

In connection with the preparation of Trip B of this field conference guidebook, the writer acknowledges the cooperation of W. T. Lytle, retired oil producer; L. G. McCorry, retired pipeliner; J. B. Stevenson, publisher of the Titusville Herald; and A. C. Thompson, Curator, Drake Well Memorial Park. Also to J. Gambel for information supplied for Trip C.

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This field conference guidebook is dedicated to the following men whose works in the Pennsylvania oil fields contributed greatly to the early advancement of the Petroleum Industry.

Colonel Edwin L. Drake, who drilled the world's first oil well at Titusville, Pennsylvania.

William A. Smith, the world's first toolpusher of Butler County, Pennsylvania.

Samuel M. Kier, the world's first crude oil refiner and refinery at Pittsburgh.

Colonel E.A.L. Roberts, inventor of the world's first oil well torpedo first used in Titusville.

Samuel Van Syckel, who laid the world's first successful crude oil pipe line between Pithole and Miller, Pennsylvania.

Cyrus D. Angell, of Franklin, Pennsylvania, who first successfully proved his theory that oil existed in "Belts".

John F. Carll, of the 2nd Geological Survey, pioneer petroleum geologist.

John A. Mather, of Titusville, who pictorially recorded the beginning of the oil industry.

John L. McLaurin, of Franklin, who recorded the history of the early oil days.